

5. NATURE AND EXTENT OF SOIL CONTAMINATION

This section describes the nature and extent of contamination for the Operable Unit (OU) 3-14 sites (Figure 5-1). For each release site, the following are presented:

- A conceptual model of the release
- An estimate based on process knowledge of the volume and composition of the contaminated liquid released
- Historical and new soil concentration data to support and/or refine the conceptual model of releases at each site
- The nature and extent of contamination.

A brief description of each site is provided on Table 5-1.

The source terms for each site are based on process knowledge, operational records and reports, unusual occurrence reports prepared at the time of discovery of the leak or spill, results from field surveys, field logbooks, and analytical data from sampling of alluvium at the contamination sites and tank farm waste. Table 5-2 presents the estimated volume and composition of the contaminated liquid released at each site. Table 5-3 presents the relative percentage that each site contributes to the total estimated mass or activity of a contaminant released in OU 3-14. A value of 0.00% does not necessarily mean that a contaminant was not released at the site; instead, this value means the contaminant accounts for less than 0.005% of the total release of that contaminant in OU 3-14. These tables are useful in determining which are the major release sites and which releases are relatively small. As shown, Site CPP-31 accounts for 87.5% of the Sr-90 and Cs-137, 89% of the Tc-99, and 20% of the I-129 released at OU 3-14. Sites CPP-28, CPP-79 (deep), and CPP-27/33 account for 12% of the Sr-90 and 10.7% of the Tc-99. All other sites account for less than 0.05% of the Sr-90 and Tc-99. Besides CPP-31, the I-129 also comes from CPP-79 (deep) (28%), CPP-27/33 (26%), CPP-28 (12%), and CPP-79 (shallow) (11%), with less than 3% from all other sites.

The development of the source term is discussed for each individual site, beginning with Site CPP-15 in Section 5.2. More details on source terms can be found in Appendix E. The source terms for the sites contributing the vast majority of the mass or activity (CPP-31, CPP-27/33, CPP-28, and CPP-79 [deep]) were generated using waste sample data supplemented by ORIGEN2 model-based estimates for those radionuclides for which sample data did not exist. Details of the ORIGEN2 computer modeling can be found in Appendix E. A discussion on how the mass of Cr, Hg, and As released was estimated can also be found in Appendix E (see February 15, 2005, Interoffice Memorandum from M. C. Swenson in the appendix). Because the remaining sites contributed a very small fraction of the contamination, source terms were developed only for the groundwater contaminants of concern (COCs) for these remaining sites. U-234, Np-237, Pu-239, Pu-240, and Am-241 source terms were calculated by determining the average ratios of each of these isotopes to Cs-137 generated by ORIGEN2 for the four major release sites, and multiplying each ratio by the individual site Cs-137 source to generate a source term.

Tables 5-2 and 5-3 do not subtract the contamination removed during previous cleanups. The primary reasons for not subtracting the excavated soil from the source term are because there is uncertainty associated with how much contaminated backfill was reused at each site and because the soil removed accounts for less than 8% of the total activity (the two sites with the highest activity, CPP-31 and CPP-79 [deep], have not been cleaned up).

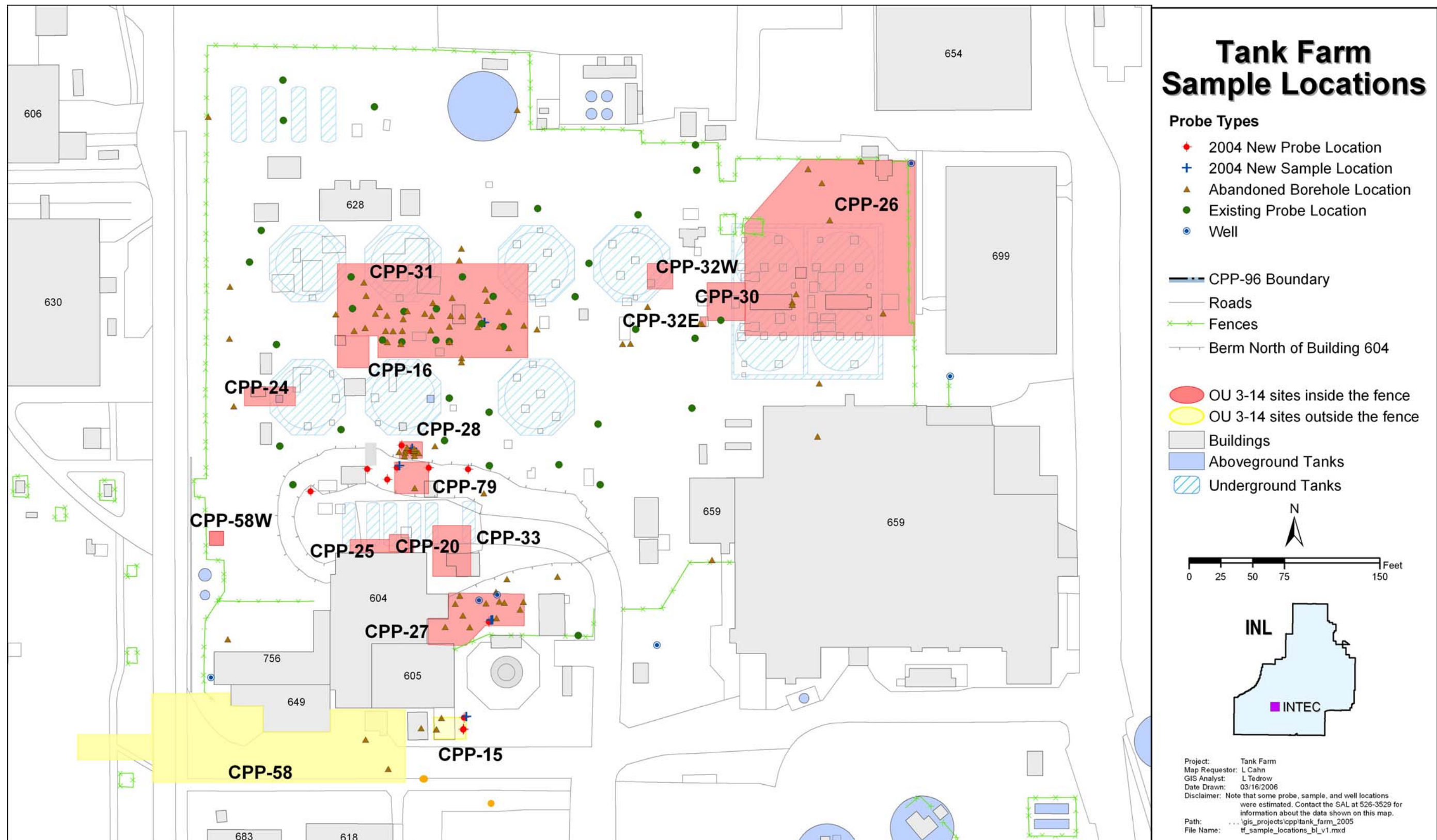


Figure 5-1. OU 3-14 release sites and sampling locations.

Table 5-1. OU 3-14 sites and release description.

Site ID	Release Description
CPP-15	Waste organic (kerosene) from first-cycle uranium extraction and condensate from main INTEC stack
CPP-16	Valve on transfer line leaked process equipment waste (PEW) evaporator concentrate
CPP-20	Several leaks of low-level activity
CPP-24	1 gal of condensate that formed in the waste storage vessel off-gas system and drained into WM-180
CPP-25	Leak from temporary line transferring waste from WM-181 to WL-102
CPP-26	One-time failure of temporary piping components, leaking 2 gal of high-activity waste
CPP-27/33	Back-up of acidic solution from Waste Calcining Facility (WCF) to PEW evaporator dissolved the line and leaked 540 gal to soil.
CPP-28	First-cycle raffinate that leaked from Line PUA-1005
CPP-30	Spread of loose contamination by personnel from a valve box to the environment (was cleaned up immediately)
CPP-31	Sodium-bearing waste (SBW) leaked during a transfer from WM-181 to WM-180
CPP-32E	First-cycle coprocessing raffinate leaked from valve inside Box B-2 into the sump
CPP-32W	1 gal of slightly contaminated water from a temporary, aboveground piping system
CPP-58	Three leaks due to line failure from extreme temperature variation
CPP-58W	PEW evaporator condensate leak west of NW corner of CPP-604
CPP-79 (shallow)	Two leaks of PEW evaporator feed solution
CPP-79 (deep)	Failed valve flange gaskets in Boxes A3A and A3B
CPP-96	Consolidation of all OU 3-14 sites and contaminated backfill within the tank farm

Table 5-2. Source term for all 3-14 release sites. Values shown, in Ci or kg by year of release, are not decay-corrected. Refer to duration sheet for release duration (Appendix A, Table 8-6).

Composition	Site																			Total (Ci)
	CPP-31	CPP-28	CPP-79 (deep)	CPP-27/33	CPP-15	CPP-16	CPP-20	CPP-24	CPP-25	CPP-26	CPP-30	CPP-32E	CPP-32W	CPP-58E	CPP-58	CPP-58	CPP-58W	CPP-79 (shallow)	CPP-112	
	Estimated Release Month and Year																			
Nov-72	1974	1967, 1973, 1973	1964, 1966, 1967	1974	1976	1958- 1978	1954	1960	1964	Jun-75	Dec-76	1976	1976	1977	1980	Aug-54	1986	2003		
H-3 (Ci)	2.34E+00	5.59E-01	5.26E+00	1.20E+00	1.20E-04	1.10E-03	3.00E-05	1.30E-02	2.00E-04	2.00E-02	1.50E-06	2.00E-06	1.96E-06	6.80E-03	5.27E-01	71.84E-03	3.60E-02	1.80E-01	1.04E-05	1.01E+01
C-14 (Ci)	2.51E-05	8.97E-07	1.32E-06	8.80E-07	— ^a	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.81E-05
Co-60 (Ci)	1.84E+01	7.25E-01	5.36E-01	0.00E+00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.96E+01
Sr-90 (Ci)	1.59E+04	6.62E+02	8.74E+02	7.20E+02	1.50E-01	6.10E-01	8.00E-03	6.00E-06	2.30E-01	7.60E+00	7.00E-03	2.00E-03	2.32E-03	9.40E-05	1.15E-04	7.28E-05	3.60E-05	1.30E+00	4.01E-06	1.81E+04
Tc-99 (Ci)	3.17E+00	1.10E-01	1.50E-01	1.20E-01	2.40E-05	1.30E-04	1.00E-06	6.70E-06	4.90E-05	1.10E-03	1.10E-06	3.00E-07	3.87E-07	1.60E-04	3.11E-05	1.05E-05	3.60E-05	2.60E-04	—	3.56E+00
I-129 (Ci)	2.51E-04	1.52E-04	3.57E-04	3.30E-04	3.00E-06	9.30E-08	2.00E-09	6.70E-07	8.10E-08	1.20E-06	1.60E-09	4.00E-10	5.32E-10	1.60E-05	3.11E-06	1.05E-06	3.60E-06	1.40E-04	—	1.27E-03
Cs-137 (Ci)	1.67E+04	6.90E+02	9.40E+02	7.50E+02	1.50E-01	8.10E-01	8.00E-03	5.00E-06	3.00E+00	7.60E+00	7.00E-03	2.00E-03	2.42E-03	2.60E-04	2.78E-04	1.06E-05	3.60E-05	1.30E+00	4.16E-05	1.91E+04
U-232 (Ci)	3.84E-06	3.11E-07	1.13E-05	1.23E-05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.78E-05
U-233 (Ci)	1.84E-06	6.76E-11	3.57E-07	4.12E-07	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.61E-06
U-234 (Ci)	4.34E-02	8.28E-06	4.98E-05	1.05E-04	3.43E-07	1.85E-06	1.83E-08	1.14E-11	6.85E-06	1.74E-05	1.60E-08	4.57E-09	5.53E-09	5.94E-10	6.35E-10	1.10E-10	8.22E-11	2.97E-06	—	4.36E-02
U-235 (Ci)	1.57E-03	3.59E-07	1.69E-03	2.78E-03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6.04E-03
U-236 (Ci)	2.34E-04	1.38E-06	4.04E-04	3.83E-03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4.47E-03
U-238 (Ci)	3.67E-04	2.83E-09	2.35E-04	3.01E-05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6.33E-04
Np-237 (Ci)	2.51E-02	5.80E-06	1.22E-03	8.98E-04	2.14E-07	1.15E-06	1.14E-08	7.12E-12	4.27E-06	1.08E-05	9.97E-09	2.85E-09	3.45E-09	3.70E-10	3.96E-10	1.01E-10	5.13E-11	1.85E-06	—	2.72E-02
Pu-238 (Ci)	7.68E+00	8.28E+00	2.35E+00	4.24E-01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.87E+01
Pu-239 (Ci)	4.34E+00	2.97E-02	2.44E+00	1.23E-01	5.45E-05	2.95E-04	2.91E-06	1.82E-09	1.09E-03	2.76E-03	2.55E-06	7.27E-07	8.80E-07	9.45E-08	1.01E-07	2.57E-80	1.31E-08	4.73E-04	—	6.94E+00
Pu-240 (Ci)	1.00E+00	1.04E-02	2.26E-02	3.27E-02	8.39E-06	4.53E-05	4.48E-07	2.80E-10	1.68E-04	4.25E-04	3.92E-07	1.12E-07	1.35E-07	1.45E-08	1.56E-08	3.95E-09	2.01E-09	7.27E-05	—	1.07E+00
Pu-241 (Ci)	6.68E+01	1.17E+00	4.23E-01	4.20E+00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7.57E-07	7.26E+01
Pu-242 (Ci)	1.60E-04	3.38E-06	2.73E-06	6.53E-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.73E-04
Pu-244 (Ci)	1.67E-11	2.14E-13	5.08E-13	5.57E-13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.80E-11
Am-241 (Ci)	2.00E+00	6.90E-03	4.98E-03	1.65E-02	1.60E-05	8.63E-05	8.52E-07	5.33E-10	3.20E-04	8.10E-04	7.46E-07	2.13E-07	2.58E-07	2.77E-08	2.96E-08	7.52E-09	3.83E-09	1.38E-04	—	2.03+00
Total (Ci)	3.27E+04	1.36E+03	1.83E+03	1.48E+03	3.00E-01	1.42E+00	1.60E-02	1.30E-02	3.23E+00	1.52E+01	1.40E-02	4.00E-03	4.74E-03	7.33E-03	5.27E-01	1.99E-03	3.16E-02	2.78E+00	—	
NO ₃ (kg)	1.91E+04	1.30E+02	3.80E+02	1.10E+03	1.20E+00	7.90E+00	2.30E-01	2.30E-02	7.00E+00	2.60E+00	1.50E-03	3.00E-04	7.00E-05	1.76E+02	1.76E+02	7.04E+01	7.00E+00	7.70E+01	4.13E-02	2.14E+04
Hg (kg)	7.01E+01	5.18E-01	3.06E-01	1.44E+00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7.24E+01
Cr (kg)	1.28E+01	3.46E-01	1.43E+00	4.90E-02	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.39E-04	1.46E+01
As (kg)	4.2E-03	<1	<1	<1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.53E-04	4.2E-03
Volume Released (gal except as noted)																				
	18,600	230	400	540 WCF scrub plus 500 decon (nitric acid)	2,000 L	150	100	1	10	2	10 mL	2 mL	1	2,500	2,500	1,000	100 PEW condensate	2,530	2,000	
a. — = not estimated.																				

Table 5-3. Percent of total source term for all 3-14 release sites.

Composition	Site																		
	CPP-31	CPP-28	CPP-79 (deep)	CPP-27/33	CPP-15	CPP-16	CPP-20	CPP-24	CPP-25	CPP-26	CPP-30	CPP-32E	CPP-32W	CPP-58E	CPP-58	CPP-58	CPP-58W	CPP-79 (shallow)	CPP-112
	Estimated Release Month and Year																		
	Nov-72	1974	1967, 1973, 1973	1964, 1966, 1967	1974	1976	1958- 1978	1954	1960	1964	Jun-75	Dec-76	1976	1976	1977	1980	Aug-54	1986	2003
H-3	23.04	5.51	51.88	11.83	0.00	0.01	0.00	0.13	0.00	0.20	0.00	0.00	0.00	0.07	5.19	0.02	0.35	1.77	0.00
C-14	89.01	3.19	4.68	3.13	— ^a	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Co-60	93.58	3.69	2.73	0.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sr-90	87.50	3.65	4.82	3.97	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Tc-99	89.24	3.10	4.23	3.37	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	—
I-129	19.77	11.98	28.19	26.04	0.24	0.01	0.00	0.05	0.01	0.09	0.00	0.00	0.00	1.26	0.25	0.08	0.28	11.05	—
Cs-137	87.47	3.61	4.92	3.93	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
U-232	13.84	1.12	40.64	44.41	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
U-233	70.49	0.00	13.71	15.80	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
U-234	99.56	0.02	0.11	0.24	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	—
U-235	25.97	0.01	27.99	46.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
U-236	5.23	0.03	9.03	85.71	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
U-238	58.09	0.00	37.15	4.76	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Np-237	92.11	0.02	4.49	3.30	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	—
Pu-238	41.00	44.19	12.54	2.26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pu-239	62.54	0.43	35.20	1.76	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	—
Pu-240	93.79	0.97	2.11	3.06	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	—
Pu-241	92.02	1.62	0.58	5.78	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00
Pu-242	92.69	1.95	1.58	3.78	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pu-244	92.89	1.19	2.82	3.10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Am-241	98.54	0.34	0.24	0.81	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	—
NO ₃	89.94	0.61	1.79	5.18	0.01	0.04	0.00	0.00	0.03	0.01	0.00	0.00	0.00	0.83	0.83	0.33	0.03	0.36	0.00
Hg	96.88	0.72	0.42	1.98	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cr	87.54	2.37	9.75	0.34	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00
As	96.50	<1	<1	<1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.50
Volume Released (gal except as noted)																			
	18,600	2.30E+02	400	540 WCF scrub plus 500 decon (nitric acid)	2,000 L	150	100	1	10	2	10 mL	1-3 mL	1	2,500			100 PEW condensate	2,530	2,000

a. “—” = not estimated.

Some of the site conceptual models and release inventories in this remedial investigation/baseline risk assessment (RI/BRA) differ from the descriptions in the OU 3-14 remedial investigation/feasibility study (RI/FS) Work Plan and predecessor documents. In the OU 3-13 RI/BRA, a worst-case analysis was used to determine if the sites posed unacceptable risks. For example, it was typically assumed that all the alluvium at the site was contaminated at the maximum measured concentration from the surface down to the top of basalt (located approximately 40 ft below ground surface [bgs]) and covered an area larger than the footprint of the contaminated site. In the OU 3-14 Work Plan, a worst-case analysis of each site was used to determine whether additional sampling was required. The information presented in this OU 3-14 RI/BRA uses process knowledge and historical records relating to leak volumes, compositions, locations, failure modes, and operational practices to further refine the spatial, temporal, and chemical properties of each release. New data collected in 2004 from five of the sites were used to verify the conceptual model of the release. This information was used to develop a reasonably conservative source term with which to calibrate the groundwater fate and transport model, predict future groundwater concentrations, and make remedial action decisions.

The site-by-site descriptions present historical data and past cleanup activities. Both field screening and laboratory analytical data are presented. Field screening data are gross measurements of beta and/or gamma radioactivity measured in the field using units of exposure rate (e.g., mR/hr). Laboratory analytical data are in units of concentration and range from gross measurements (alpha and/or beta) to more precise measurements that identify concentrations of specific radioisotopes or other contaminants. At five of the sites, data gaps were identified in the OU 3-14 Work Plan that required limited additional sampling in 2004 to verify the conceptual models. These new data are presented. The spatial extent of contamination and contaminant of potential concern (COPC) concentrations is described for each OU 3-14 site and for contaminated backfill in the tank farm. Collectively, all the OU 3-14 sites are in Site CPP-96, which also includes the interstitial soils between the known release sites. Site CPP-96 was identified as a site when OU 3-14 was created in order to account for contaminated backfill that was reused outside the known release site boundaries (DOE/ID-10660, *Final Record of Decision Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13*, U.S. Department of Energy Idaho Operations Office). New sites added to OU 3-14 since the OU 3-13 Record of Decision (ROD) are included at the end of this section.

5.1 2004 Sampling and Analysis

In August and September 2004, tank farm soil characterization activities were performed to collect environmental data to support the RI/BRA and FS phases of OU 3-14. Section 5.2 of the OU 3-14 RI/FS Work Plan (DOE 2004a) describes development of data quality objectives (DQOs) for the OU 3-14 investigation. Data gaps were identified for five release sites in the general categories of extent, distribution, and composition of contamination and soil properties related to contaminant transport. Samples were collected and in situ gamma logging was performed to resolve the data gaps as described in DOE-ID (2004a). The *Tank Farm Soil and Groundwater Field Sampling Plan for the Operable Unit 3-14 Remedial Investigation/Feasibility Study* (DOE-ID 2004b) governed all sampling and analysis activities at each site.

Table 5-4 summarizes the OU 3-14 investigation strategy to resolve data gaps. Figure 5-1 shows locations of OU 3-14 probeholes and sample coreholes as well as sampling locations from previous programs. Table 5-5 summarizes the 2004 borehole types, naming conventions, and depths. Specific release site investigations are described in detail in subsequent sections.

Table 5-4. OU 3-14 field investigation strategy.

Data Gap Category	Site and Investigation Strategy				
	CPP-15	CPP-27	CPP-28	CPP-31	CPP-79 (deep)
Extent of contamination	Probe and gamma-log and collect continuous soil core to determine areal and vertical extent	NA	NA	NA	Probe and gamma-log and collect continuous soil core to determine areal and vertical extent
Data gaps resolved?	Yes	NA	NA	NA	Yes
Distribution of contamination	Probe and gamma-log and collect continuous soil core to determine areal and vertical extent	NA	NA	Probe and gamma-log and collect continuous soil core to determine whether contamination reached basalt	Probe and gamma-log and collect continuous soil core to determine areal and vertical extent
Data gaps resolved?	Yes	NA	NA	Yes	Yes
Composition of contamination	Collect one continuous core and analyze for tank farm COPCs as defined in Table 5-6	Collect one continuous core and analyze for tank farm COPCs as defined in Table 5-6	Collect one continuous core and analyze for tank farm COPCs as defined in Table 5-6	Collect one continuous core and analyze for tank farm COPCs as defined in Table 5-6	Collect one continuous core and analyze for tank farm COPCs as defined in Table 5-6
Data gaps resolved?	Yes	Yes	Yes	Yes	Yes
Soil/contaminant properties	Archive excess sample for use in contaminant transport and/or treatability studies	Archive excess sample for use in contaminant transport and/or treatability studies	Archive excess sample for use in contaminant transport and/or treatability studies	Archive excess sample for use in contaminant transport and/or treatability studies	Archive excess sample for use in contaminant transport and/or treatability studies
Data gaps resolved?	Yes	Yes	Yes	Yes	Yes

NA = no data gaps identified.

Table 5-5. Naming convention alias table and general information for 2004 boreholes.

Borehole	Official Well Name	Hydrogeologic Data Repository Well ID	Depth (ft)	OU Location (CPP-#)	Borehole Type
15-1	ICPP-1866	1866	29.2	15	45-degree angle gamma-logged probehole
15-2	ICPP-1867	1867	29.2	15	45-degree angle gamma-logged probehole
15-3	ICPP-1868	1868	45	15	Vertical gamma-logged probehole
15-Sample	ICPP-1869	1869	13.5 vertical	15	45-degree angle gamma-logged probehole/sample
27-1	ICPP-1870	1870	42.2	27/33	Vertical gamma-logged probehole
27-Sample-A	ICPP-1871	1871	15.5	27/33	Vertical gamma-logged probehole/sample
27-Sample-B	ICPP-1872	1872	20	27/33	Vertical gamma-logged probehole/sample
27-Sample-C	ICPP-1873	1873	40	27/33	Vertical gamma-logged probehole/sample
31-1	ICPP-1874	1874	39.6	31	Vertical gamma-logged probehole
31-Sample	ICPP-1875	1875	39.5	31	Vertical gamma-logged probehole/sample
28-1	ICPP-1876	1876	49.7	28	Vertical gamma-logged probehole/sample
28-2	ICPP-1877	1877	54.2	28	Vertical gamma-logged probehole
28-Sample	ICPP-1878	1878	51	28	Vertical gamma-logged probehole/sample
79-Sample-A	ICPP-1881	1881	46	79	Vertical gamma-logged probehole/sample
79-Sample-B	ICPP-1882	1882	56	79	Vertical gamma-logged probehole/sample
79-10	ICPP-1883	1883	49.3	79	Vertical gamma-logged probehole
79-5	ICPP-1884	1884	44.3	79	Vertical gamma-logged probehole
79-4	ICPP-1885	1885	49.2	79	Vertical gamma-logged probehole
79-2	ICPP-1886	1886	57.9	79	Vertical gamma-logged probehole
79-6	ICPP-1887	1887	64	79	Vertical gamma-logged probehole
79-8	ICPP-1888	1888	43.1	79	Vertical gamma-logged probehole

Characterization of the tank farm soil was implemented in two phases. The first phase of the field investigation was performed to define the extent and distribution of Cs-137 contamination in the subsurface for known release sites. Cased probeholes were installed, a gamma-logging instrument was lowered downhole, and the probeholes surveyed for gamma radiation. The downhole gamma radiation surveys show variations in gamma-ray flux at depth. This information was used as a basis to estimate the combined horizontal and vertical extent of the soil contamination zones. It also served as an indicator of zones at or below which other COPCs were likely to exist.

In the second phase of the characterization effort, soil samples were collected to define the composition of contamination at specified locations within individual release sites. Samples were then sent to an analytical laboratory for organic, inorganic, radiochemical, and toxicity characteristic leaching procedure (TCLP) analyses (Table 5-6). Probing and sampling activities were conducted at the CPP-15, CPP-27, CPP-28, CPP-31, and CPP-79 soil contamination sites.

Subsurface gamma-ray surveys were performed in existing probeholes and in new probehole locations installed in various locations. New probeholes were installed using direct-push drilling and, as necessary, hand augering in the shallowest portions of the hole. Phase 2 coreholes were installed immediately adjacent to probeholes using direct-push drilling with a dual-tube sampling system. Soil samples were collected at the specified corehole locations from the ground surface to basalt except at CPP-15, where the corehole was stopped when samples could no longer be retrieved due to the 45-degree slant of the corehole. Two 2-ft sample liners were collected from each 4-ft soil interval and gamma surveyed. The higher-activity core was subsampled for the various analyses. The volatile organics analysis grab sample was collected first. The remaining soil material was then composited in a bag prior to collection of the subsamples for the remaining analyses. For Site CPP-79, the 56- to 60-ft interval samples were all grab samples and no compositing occurred. The sampling and analysis program consisted of standardized procedures for sample collection, sample handling, analytical methods, data reporting, and quality control.

After collection, samples were properly preserved and packaged for shipment to the analytical laboratory. Samples were shipped via overnight delivery to BWXT Services located in Lynchburg, Virginia, for analysis. The laboratory is capable of handling the high radioactivity levels encountered in the tank farm alluvium. Samples were analyzed according to methods outlined in the Field Sampling Plan (DOE-ID 2004b). Upon completion of the analysis, the laboratory prepared data packages containing the data results and raw data printouts as required by the applicable contract task order statement and Environmental Restoration-Statement of Work (SOW) (ER-SOW-394). The INL Sample and Analysis Management (SAM) office was responsible for establishing the laboratory contract and ensuring that the analyses were performed according to the specifications outlined in the sampling and analysis plan (SAP). Upon receipt of the data, the Sample and Analysis Management office arranged for and performed validation of the data and issued limitations and validation reports for each data package.

Appendix F, End of Well Reports for the OU 3-14 2004 Tank Farm Soil Investigation at the Idaho Nuclear Technology and Engineering Center, documents the probing, gamma logging, and sampling activities conducted for Phases 1 and 2. The appendix also contains the results of the gamma logging.

Appendix G, New Data Tables, contains the analytical results from sample collection performed for Phase 2 of the characterization activity. Samples were collected and analyzed for total metals, TCLP metals, volatile organic compounds (VOCs), TCLP VOCs, semivolatile organic compounds (SVOCs), TCLP SVOCs, pH, nitrate, nitrite, and radionuclides. After the OU 3-14 Work Plan and Field Sampling Plan were finalized, DOE decided to add a few limited analyses to support source term identification. These included zirconium, fluoride, and Pu-241 analyses at selected locations. Appendix G tables are organized by release site and analysis type and show all reported results for the requested analyses,

Table 5-6. Analytes, laboratory analyses, and analytical methods for corehole samples during the OU 3-14 field investigation.

Category	Analyte	Method
Radionuclides	Am-241	Alpha spectroscopy or gamma spectroscopy
	Pu-238	Alpha spectroscopy
	Pu-239/240	Alpha spectroscopy
	U-233/234	Alpha spectroscopy
	U-235	Alpha spectroscopy or gamma spectroscopy
	U-238	Alpha spectroscopy
	Np-237	Alpha spectroscopy
	Tritium	Liquid scintillation counter
	Tc-99	Liquid scintillation counter
	Sr-90	Gas proportional counter
	C-14	Gas proportional counter
	I-129	Gas proportional counter or gamma spectroscopy
	Cs-137	Gamma spectroscopy
	Eu-154	Gamma spectroscopy
Inorganics	Arsenic	SW-846 ^a 7000A ^b or 7062 ^c
	Chromium	SW-846 6010/6010B ^d
	Mercury	SW-846 7470A ^e (aqueous) or 7471A ^f (nonaqueous)
Wet Chemistry	Nitrate-N	EPA-300.0 ^g , 352.1 ^h , 353.1 ⁱ , or 353.2 ^j
	Nitrite-N	EPA-300.0 ^g , 352.1 ^h , 353.1 ⁱ , or 353.2 ^j
	pH	SW-846 9045C
Organics	Appendix IX TAL-VOCs	SW-846 8260B ^k
	Appendix IX TAL-SVOCs	SW-846 8270C ^l
TCLP	Metals and organics	SW-846 1311 ^m

SVOC = semivolatile organic compound.

TAL = target analyte list.

TCLP = toxicity characteristic leaching procedure.

VOC = volatile organic compound.

a. All SW-846 methods cited in this table are extracted from "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods."

b. SW-846, Method 7000A, "Atomic Absorption Methods."

c. SW-846, Method 7062, "Antimony and Arsenic (Atomic Absorption, Borohydride Reduction)."

d. SW-846, Method 6010/6010B, "Inductively Coupled Plasma-Atomic Emission Spectrometry."

e. SW-846, Method 7470A, "Mercury in Liquid Waste (Manual Cold-Vapor Technique)."

f. SW-846, Method 7471A, "Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique)."

g. EPA Method 300.0, "Determination of Inorganic Anions by Ion Chromatography."

h. EPA Method 352.1, "Nitrate (Colorimetric, Brucine)."

i. EPA Method 353.1, "Nitrate-Nitrite (Colorimetric, Automated Hydrazine Reduction)."

j. EPA Method 353.2, "Nitrate-Nitrite (Colorimetric, Automated Cadmium Reduction)."

k. SW-846, Method 8260B, "Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry."

l. SW-846, Method 8270C, "Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry."

m. SW-846, Method 1311, "Toxicity Characteristic Leaching Procedure."

including those compounds that were not detected. Laboratory-assigned and independent-validator-assigned flags are included in the tables along with the appropriate definitions.

The individual laboratory data packages and limitations and validation reports contain detailed and extensive narrative and review of each data point. In addition, the raw data, instrument printouts, calibration results, etc. can be found in the data packages. The detailed data tables in Appendix G contain references to the individual data packages. For a more detailed review of any individual data point than is presented in the RI/BRA, the applicable data package should be examined.

Select data are summarized in Table 5-7 without validation flags or uncertainties to provide an overview of the results. For the CPP-31 site 16- to 18-ft depth interval, field radiological screening surveys of the soil core indicated that the total beta/gamma activity was above 500 mR/hr. Therefore, the soil core could not be subsampled in the field due to procedural handling restrictions. The soil core was subsampled inside a shielded hot cell in 2005 and analyzed for a limited number of constituents. In addition, two results are reported for the Pu-238, Pu-239/240, and Np-237 analyses of CPP-79 34- to 36-ft depth and 56- to 60-ft depth. During project review of the initial sample results (in parentheses on Table 5-7), it was noted that these particular results were unusual. At the project's request, the laboratory performed a second analysis of the remaining sample material. Both sample results are basically in agreement and both numbers are reported in the table. However, the Np-237 result for the 34- to 36-ft depth was approximately 10 times lower than the original sample and more closely matched the project knowledge of the sampling site.

Appendix H, Quality Assurance/Quality Control and Data Issues, contains a discussion and evaluation of the specific quality requirements for the sampling and analysis performed under Phase 2. Specific quality assurance/quality control (QA/QC) requirements for the sampling and analysis activities were discussed in the Field Sampling Plan (DOE-ID 2004b) and the *Quality Assurance Project Plan for WAGs 1, 2, 3, 4, 5, 6, 7, 10, and Deactivation, Decontamination, and Decommissioning* (DOE-ID 2004c), referred to as the Quality Assurance Project Plan (QAPjP). The QA objectives specified which measurements must be obtained to produce acceptable data for the project. The technical and statistical qualities of these measurements are documented in Appendix H.

The following subsections address each individual release site, including a description of the release, summary results of previous investigations and the 2004 investigation, and a discussion of the nature and extent of contamination.

5.1.1 References

DOE-ID, 2004a, *Operable Unit 3-14 Tank Farm Soil and Groundwater Remedial Investigation/ Feasibility Study Work Plan*, DOE/ID-10676, Rev. 1, U.S. Department of Energy Idaho Operations Office, June 2004.

DOE-ID, 2004b, *Tank Farm Soil and Groundwater Field Sampling Plan for the Operable Unit 3-14 Remedial Investigation/Feasibility Study*, DOE/ID-10764, Rev. 1, U.S. Department of Energy Idaho Operations Office, June 2004.

DOE-ID, 2004c, *Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10, and Deactivation, Decontamination, and Decommissioning*, DOE/ID-10587, Rev. 8, U.S. Department of Energy Idaho Operations Office, March 2004.

ER-SOW-394, 2005, "Sample and Analysis Management Statement of Work for Analytical Services," Rev. 3, Idaho National Engineering and Environmental Laboratory, March 2005.

Table 5-7. FY-04 soil sampling summary. (Table contains no laboratory or validation flags, maximum detectable amounts, or uncertainty. [< = U or UJ flag; 0 = compound detected at low level, i.e., decimal places not shown.])

Units	Depth ft	Cs-137 pCi/g	Sr-90 pCi/g	Pu-238 pCi/g	Pu-239/240 pCi/g	I-129 pCi/g	Tc-99 pCi/g	Hg mg/kg	pH	H-3 pCi/g	Co-60 pCi/g	Eu-154 pCi/g	Nitrate-N mg/kg	Am-241 pCi/g	U-233/234 pCi/g	U-235 pCi/g	U-238 pCi/g	Np-237 pCi/g	Cs-134 pCi/g	C-14 pCi/g	Cr mg/kg	As mg/kg	Pu-241 pCi/g	Fluoride mg/kg	Zr mg/kg
CPP-27	2-4	0	<	<	<	<	<	0.03	9.1	<	<	<	3	<	0	0	0	<	<	<	32	11			
	6-8	40	126	0.12	0	<	<	0.04	8.9	<	0	<	3	0	1	0	1	<	<	<	25	10			
	10-12	25	8	<	<	<	<	0.05	9.1	<	0	<	4	0	0	0	0	<	<	<	26	11			
	14-16	288	711	0.11	<	<	<	0.05	9.3	<	0	0	3	0	0	0	1	<	<	<	31	8			
	18-20	7	24	<	<	<	4	0.02	9.2	<	0	<	3	0	1	0	1	<	<	<	32	11			
	20-24	<	<	<	<	<	7	0.03	9.2	<	<	<	3	<	1	0	1	<	<	<	34	6			
	24-28	<	<	<	<	<	3	0.03	8.7	<	<	<	2	<	1	0	1	<	<	<	42	11			
	28-32	<	<	<	<	<	<	0.03	8.6	<	<	<	3	0	1	0	1	<	<	<	28	9			
	32-36	<	<	<	<	<	<	0.02	8.3	<	<	<	2	<	1	0	1	<	<	<	26	13			
CPP-15 (slant)	1.4-2.8	59	27	0	0	<	<	0.10	9.1	<	<	<	4	0	1	0	1	<	<	<	28	10			
	4.2-5.7	90	12	0	0	<	4	0.10	9.1	<	0	<	3	0	1	0	1	<	<	<	22	10			
	7.1-8.5	85	21	0	0	<	11	0.07	9.2	<	0	0	4	0	1	0	0	0	<	<	25	14			
	9.9-11.3	47,000	7,180	1,080	213	<	15	0.53	8.8	<	1	39	4	187	99	<	<	2	<	<	21	5			
	11.3-12.7	5,830	13,900	83	18	<	26	0.59	8.9	<	2	56	3	37	3	<	<	1	<	<	35	10			
CPP-31	0-4	214	<	<	<	<	<	0	9.2	<	<	<	0	1	1	<	1	<	<	<	29	<			
	6-8	438	175	1	<	<	<	0	9.1	<	<	<	0	<	1	<	1	<	<	<	38	<			
	10-12	428	815	3	1	<	<	0	9.1	<	<	<	0	1	2	1	1	<	<	<	27	<			
	14-16	241,000	547,000	958	202	<	13	5.49	9.1	<	<	247	0	128	6	2	1	0	<	<	29	<			
	16-18	3,720,000	1,320,000					0.63			<	1,600						<							
	18-20	8,990,000	1,850,000	41,800	8,530	<	69	38.50	8.5	<	<	9,620	0	8,970	432	133	47	20	<	<	60	<			
	22-24	57,500	20,700,000	100	22	<	23	27.10	9.0	<	<	<	0	17	4	0	1	0	<	<	23	<			
	26-28	63	810,000	<	<	<	25	0.56	9.2	<	<	<	0	<	2	<	1	<	<	<	31	<			
	30-32	126	663,000	1	<	<	17	0.46	9.2	<	<	<	0	<	2	1	1	<	<	<	27	<			
	32-36	73	941,000	<	<	<	16	0.15	9.2	<	<	<	0	0	2	<	1	<	<	<	34	<			
	36-40	33	528,000	<	<	<	7	<	9.4	<	<	<	0	<	2	0	1	<	<	<	33	<			
	36-40 dup	32	603,000	1	<	<	65	0	9.5	<	<	<	0	<	2	0	1	<	<	3	34	<			
CPP-28	2-3	1,070	78	0	0	<	<	0.05	9.2	<	<	1	4	0	1	0	0	<	<	<	26	<			
	6-7	217	34	0	0	<	3	0.04	9.3	<	<	0	2	0	1	0	1	<	<	<	26	<			
	8-12	1,180	32,600	6	0	<	16	0.01	9.0	<	6	176	1	R	1	<	1	<	<	<	22	<	7	<	18
	12-16	1	21,600	<	<	<	100	0.01	8.8	<	<	<	1	<	1	0	1	<	<	<	28	<			
	16-20	3	3,040	<	0	<	4	0.02	9.0	<	<	<	<	<	1	0	1	<	<	<	22	<			
	20-24	0	3,950	<	<	<	4	0.07	9.1	<	<	<	1	0	1	0	1	<	<	<	23	<			
	20-24 dup	1	2,460	<	0	<	3	0.08	9.1	<	<	<	1	0	1	0	1	<	<	<	16	<			
	24-28	3	56	0	0	<	3	0.01	9.2	<	<	<	1	<	0	<	0	<	<	<	25	<			
	28-32	2,540,000	223,000	12,600	8,160	<	196	0.46	8.8	<	93	3,770	1	2,000	270	<	<	33	<	<	24	<	13,700	5	17
	32-36	110	379,000	0	0	<	40	0.09	8.5	<	<	<	1	0	1	0	1	<	<	<	41	<			
	36-40	1	1,950	<	<	<	3	<	9.2	<	<	<	<	<	1	0	1	<	<	<	26	<			
	40-44	1	95	<	<	<	7	0.02	9.1	<	<	<	<	<	1	0	1	<	<	<	20	<			
	44-48	4	19	<	<	<	5	<	9.2	<	<	<	1	0	1	0	1	<	<	<	37	<			
	48-52	2	18,000	0	<	<	2	0.02	9.4	<	<	<	1	<	1	<	1	<	<	<	19	<			
	52-56	1	85,200	<	<	<	3	0.02	9.2	<	<	<	1	<	1	0	1	<	<	<	27	<	2	<	19
CPP-79	2-4	30	20	0	<	<	3	0.02	9.0	<	<	<	1	0	2	0	1	<	<	<	27	12			
	6-8	53	48	0	0	<	2	0.02	9.1	<	<	<	1	0	1	0	1	0	<	<	60	8			
	10-12	78	76	0	0	<	1	0.02	9.0	<	<	<	1	0	1	0	1	0	<	<	31	8			
	14-16	110	38	1	0	<	1	0.02	8.9	<	<	<	1	0	1	0	1	<	<	<	33	5			
	16-18	19,600	25,900	21	6	<	33	0.05	8.9	<	8	123	3	6	1	0	1	0	<	<	27	10	91	2	14
	20-22	0	29,200	<	<	<	22	0.03	8.5	<	<	<	3	<	1	0	1	<	<	<	38	10			
	24-26	0	13,400	<	<	<	65	0.02	9.0	<	<	<	1	0	1	0	1	0	<	<	30	10			
	30-32	0	9	0	0	<	19	0.06	9.2	<	<	<	1	0	2	0	1	0	<	<	30	10			
	34-36	3,350,000	219,000	(21,100) 4,300	(8800) 23,600	<	182	7.61	9.0	<	<	2,860	1	2,330	316	<	<	(468) 48.5	<	<	37	10	18,700	2	32
	36-38	1,770	60,100	15	8	<	15	0.01	8.3	<	<	<	0	0	1	0	1	0	<	<	44	8			
	42-44	455	6	1	1	<	4	0.02	8.9	<	<	<	4	0	1	0	1	<	<	<	27	9			
	44-46	300	10	1	0	<	2	0.03	8.7	<	<	0	9	0	1	0	1	<	<	<	42	9			
	44-46 dup	301	8	1	0	<	3	0.03	8.7	<	<	<	8	0	1	0	1	0	<	<	35	9			
	48-52	293	126	1	0	<	3	0.03	8.9	<	<	0	7	0	1	<	1	<	<	<	31	10			
	52-56	31	25	0	0	<	2	0.02	8.9	<	<	<	5	<	1	0	1	0	<	<	34	10			
	56-60	1,350,000	34,700	(10,700) 4,000	(14,600) 9,500	<	13	0.06	8.9	<	<	<	6	773	334	<	<	(69.9) 97.4	<	<	26	9	613	5	18

5.2 CPP-15

CPP-15 is near the site of the former solvent burner, is located just outside the tank farm boundary near the southeast corner of Building CPP-605 (Figure 5-2), and is under a transformer pad and electrical duct bank.

5.2.1 Description of Release

CPP-15 was contaminated by (a) waste organic (kerosene) produced by the first-cycle uranium extraction process and (b) condensate from the main INTEC stack. The contamination occurred when construction activities cut the stack drain line and closed a valve on a temporary drain system.

5.2.1.1 Background of System Configuration and Leak. Site CPP-15 is a small site located a short distance southwest of the main INTEC exhaust stack (CPP-708) and is associated with the operation of the solvent burner system (see Figures 1-2 and 5-1). The uranium recovery system in CPP-601 was based on solution chemistry and species solubility. The uranium extraction system mixed the aqueous fuel dissolver product, which contained both uranium and radioactive fission products, with an immiscible organic (solvent) solution. By controlling the chemistry of the solutions, the uranium was extracted from the aqueous phase into the organic phase, leaving the bulk of the fission products in the aqueous solution. The uranium-bearing organic solution was separated from the fission product-bearing aqueous solution and mixed with a new aqueous stream. By changing the solution chemistry, the uranium was extracted from the organic into the new aqueous solution. The net result was two aqueous solutions, one with the bulk of the fission products (which became first-cycle raffinate) and one with the recovered uranium. The organic solution was recycled and used over and over to extract the uranium from the aqueous dissolver product and transfer it to the new aqueous solution.

For most of the fuel reprocessing history, the organic solution used in the first-cycle extraction system was a high grade of kerosene containing about 5% tributyl phosphate (TBP). The second- and third-cycle uranium purification systems were similar to the first-cycle system, but used hexone as the organic. Over time, the first-cycle organic solution degraded due to radiation and collected impurities that hampered uranium recovery. As a result, the organic was periodically replaced. The used organic was sent to an underground, interim storage in tank, LE-102, located a few feet southwest of the main INTEC stack (CPP-708). Periodically, the waste organic was pumped out of LE-102 and burned in a furnace that exhausted to the main INTEC exhaust stack. The hexone used in the second and third cycle did not accumulate degradation products as the first-cycle organic did, and never needed replacing. Hence, the solvent burner was used only for first-cycle organic raffinate, not for hexone.

Use of the solvent burner ceased in the early 1980s when a new organic waste collection system (NCE-184, -185, and -186) was built and the organic solution was burned in the calciner as supplemental fuel for the kerosene normally burned by the calciner to generate process heat.

There was a possibility that some water could be transferred from CPP-601 to LE-102 along with the waste organic. Should this occur, an aqueous transfer line could remove water from the bottom of LE-102 and send it to the PEW evaporator feed collection tank, WL-102. That transfer line connected to the gravity drain line from the bottom of the INTEC exhaust stack. In March 1974, construction of a new PEW evaporator cell on the east side of CPP-604 was underway. That project cut the stack drain line, which ran through the construction area, in order to facilitate construction activities. Valves were installed and closed on each end of the cut drain line during construction work. A hose connected the two ends of the drain line when construction was not in progress, and the valves were opened to allow liquid in the stack to drain to WL-102.

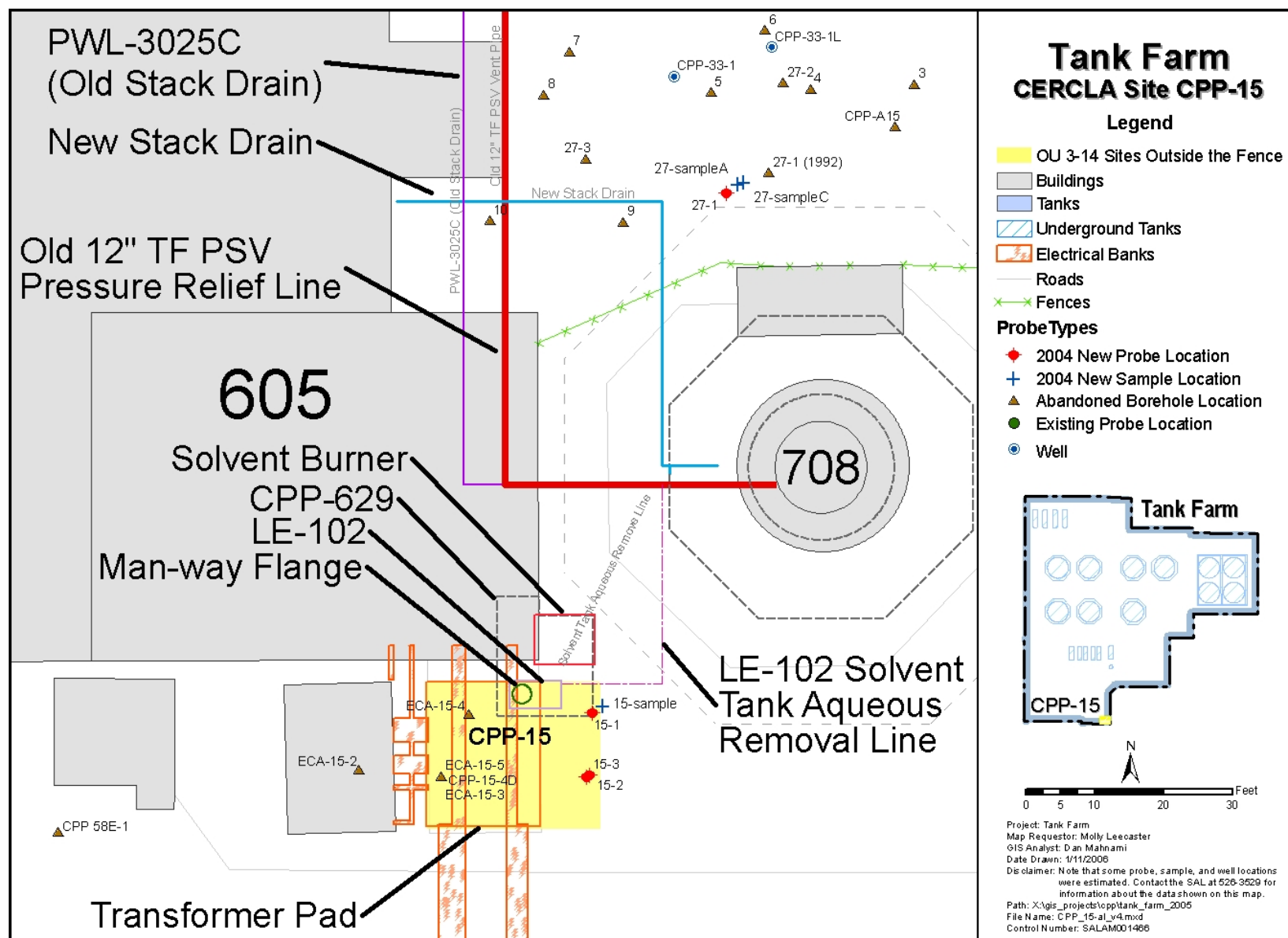


Figure 5-2. CPP-15 detailed map.

In March 1974, the drain valves remained closed too long and allowed condensate to collect in the base of the stack. The condensate went down the stack drain line and then backed up into the waste organic storage tank, LE-102, via its aqueous removal line that connected to the stack drain line. As condensate from the stack filled LE-102, the waste organic level rose until it spilled out of a flange on a tank manway that came to the surface in the small solvent storage building, CPP-629. The organic waste ran across the concrete floor of the building and out onto the ground, resulting in the contamination at Site CPP-15. The incident is documented in a Significant Operating Occurrence Report (Lohse 1974). Cleanup (removal) of the near-surface contamination occurred immediately after the event. Additional cleanup occurred in the mid 1980s when the waste solvent burner and LE-102 were removed and in fall 1995 when 39 waste boxes of contaminated soil and the concrete footing for the old stack preheater were removed during installation of the transformer pad and electrical duct banks over the site.

5.2.1.2 Waste Source Term. The release at CPP-15 likely involved two separate source terms, one for the organic and one for the aqueous portion of the release. Lohse (1974) indicates the 2,000-L solvent tank was partly full prior to the incident. The event likely added enough condensate to the tank to force all of the organic to spill out of the tank, followed by some aqueous overflow as well. The organic phase was low in fission products, but relatively high in transuranic (TRU) activity, based on process chemistry and historical sample data. This was because the actinides (Pu, Np, Am, etc.) had a solution chemistry similar to that of uranium, and a higher portion of those species (compared to the fission products) were extracted from the dissolver product into the organic during the first-cycle extraction process. Thus, the organic waste had a significantly different radionuclide source term than tank farm and other aqueous wastes. The waste organic had a very low gamma activity (fission products), but a high alpha activity (TRU components). Girton (1983) provides a source term for the major constituents of the waste organic based upon historical sample analyses. The activity of Tc-99 was not in Girton (1983) but was calculated based on its fission yield ratio to Cs-137 for coprocessing waste (Wenzel 2004). Table 5-8 shows the source term for the major components of the organic waste.

Table 5-8. Estimate of major radionuclides and nitrate released at Site CPP-15 in the organic portion of the waste.

Cs-137	Sr-90	H-3	Tc-99	I-129	NO ₃	Pu
7.0E-06 μCi/mL	6.0E-06 μCi/mL	Negligible ^a	1.1E-09 μCi/mL	3.0E-06 μCi/mL	Negligible ^a	1.0E-03 μCi/mL
a. Because the waste organic contained no water, the tritium activity and nitrate content were negligible.						

The bulk of the CPP-15 contamination was removed shortly after the release and during the removal of the solvent burner and organic storage tank in the mid 1980s. The site was again excavated to 10 ft in 1995 and contaminated soil was removed. The deeper samples collected in February 1996 from 10.5 ft bgs and in 2004 from 9.9 to 12.7 ft bgs have elevated Cs-137 and Sr-90 activity and low Pu activity.

The relatively high Cs-137 and low Pu radionuclide activities found in 1995, 1996, and 2004 are not consistent with the organic waste source term given above. Some of the contamination came from an aqueous waste. Condensate from the stack flowed into LE-102, forcing the waste organic to overflow. After the organic layer had overflowed, some of the stack condensate may have also overflowed. The stack condensate would have been relatively high in Cs-137 activity compared to the waste organic. The incident occurrence report indicates that the soil surface radiation after the spill was 3 R/hr. That radiation was too high to have been generated by the organic waste. By comparison, the waste organic storage tanks (NCE-184, -185, and -186) built to replace LE-102 were built aboveground without any radiation shielding because the fission product content of the waste organic was so low. The 3-R/hr soil radiation

reading was about the same as surface contamination from condensate that seeped from the base of the stack (Site CPP-29) later that year (November), which measured 1.5 R/hr (Staiger 1974). The similar soil surface radiation readings indicate that some of the CPP-15 contamination came from stack condensate (with relatively high Cs-137 activity) that overflowed LE-102.

A sample from the November 1974 stack seepage waste had a gross beta activity of 0.6 $\mu\text{Ci/mL}$ (Staiger 1974). Assuming equal activities of Cs-137, Sr-90, and Y-90 and the total activities of Ru-106/Rh-106 and Ce-144/Pr-144 equal to that of Cs-137, the Cs-137 and Sr-90 activities were each about one-fourth of the measured gross beta activity or 0.15 $\mu\text{Ci/mL}$. These fission product activities are four orders of magnitude higher than that in the organic portion of the waste. This means the aqueous condensate from the stack likely contributed the bulk of the fission product contamination to the soil. However, the organic portion was a significant contributor of the TRU components. The aqueous source term, based upon the November 1974 gross beta analysis, is given in Table 5-9.

Table 5-9. Estimate of major radionuclides and nitrate released at Site CPP-15 in the aqueous portion of the waste.

Cs-137	Sr-90	H-3	Tc-99	I-129	Pu	NO ₃
0.15 $\mu\text{Ci/mL}$	0.15 $\mu\text{Ci/mL}$	1.2E-04 $\mu\text{Ci/mL}$	2.4E-05 $\mu\text{Ci/mL}$	3.3E-08 $\mu\text{Ci/mL}$	1.8E-03 $\mu\text{Ci/mL}$	0.02 M

The aqueous source term uses fission yield values relative to Cs-137 from Wenzel (2004) for Tc-99, I-129, H-3, and Pu. The calciner was not in operation in March 1974. Thus, the major radionuclides in the condensate likely came from residues inside the stack that were rinsed off by the condensate not from adsorption of volatile material from the calciner off-gas. The aqueous source term likely overestimates the H-3 and I-129 in the stack condensate because those isotopes likely did not form solid residues in the stack that would be in the stack condensate. Without the calciner operation, the nitrate content of the condensate would have been low because the nitric-acid-forming NO_x content of the stack gas would have been low. The nitrate in the condensate was likely 0.02 M or less.

Lohse (1974) indicates the waste flowed from the manway, across the concrete floor of the waste organic building, and out onto the soil, contaminating the near-surface soil. Some of the waste may have seeped between the tank manway and the building floor and down along the manway, causing the deeper areas of contamination found in the 2004 soil sampling.

5.2.1.3 Waste Volume Released. The incident occurrence report made no estimate of the volume of waste released to the site. It states that the solvent tank was initially partly full of organic waste. A reasonable assumption is that the tank was half full of organic waste, about 1,000 L, all of which overflowed onto the ground. The volume of condensate that formed and overflowed is also unknown. The condensate volume was limited by practical concerns. The spill area was next to a road/walkway that was used by people walking between the WCF and other areas of the plant. A large spill that extended over a large area would likely have been noticed by passersby. There were no major flows of moist air into the stack that would form large volumes of condensate. The calciner off-gas was the largest source of moist gas into the stack, but it was not in operation when the spill occurred. Other sources of moisture included the steam jets used to maintain a vacuum on the Zr fuel dissolver and vessel off-gas systems. The jets may have produced some steam condensate, but it was likely a small amount. A condensation rate of 5 gph is a reasonable estimate for the amount of condensate produced. During fuel dissolution and uranium extraction operations, waste organic is produced and must be burned. As a result, operators or maintenance personnel would have entered the solvent burner building periodically to operate the facility or perform maintenance. In fact, the spill was discovered by maintenance personnel

who entered the building to perform maintenance. Given these facts, it is unlikely the overflow situation existed for more than a few days.

A 5-gph leak would produce 120 gal (about 500 L) of condensate a day. It would take about 2 days for a tank that was half full of organic to fill with an organic/condensate mixture, another 2 days to force the organic (1,000 L) out of the tank and fill the tank with condensate, and another 2 days for 1,000 L of condensate to overflow onto the ground. This is a 6-day event, including 4 days of liquid leaking out of the flange. It is likely someone would have noticed the leak in that amount of time or less. Therefore, a volume of 1,000 L each of organic and stack condensate is assumed to have leaked at the site. There is considerable uncertainty in this estimate, likely a factor of two, but the release was likely hundreds of gallons not thousands of gallons.

5.2.1.4 Source Term Summary. CPP-15 was contaminated by (a) waste organic (kerosene) produced by the first-cycle uranium extraction process and (b) by condensate from the main INTEC stack. The contamination occurred when construction activities cut the stack drain line and closed a valve on a temporary drain system. Condensate formed in the stack, went down the stack drain line, and flowed into the waste organic storage tank, LE-102, via a water removal line that joined the stack drain line. The flow of stack condensate into LE-102 caused the organic waste to rise until it overflowed the tank via a ground-level flange on a tank manway. Condensate flowed from the stack into LE-102 until all the organic waste was forced out of the tank and then condensate overflowed the tank. This report assumes approximately 1,000 L each of organic waste and condensate flowed out of the tank and onto the surface of the soil. Some of the waste likely seeped down along the tank manway and contaminated a deep area of soil (12 ft below grade) in addition to the surface contamination.

A release of 1,000 L each of the organic waste and stack condensate spilled from the LE-102 tank with the source terms given in Tables 5-8 and 5-9 results in estimated releases of the material shown in Table 5-10. The release estimates in Table 5-10 have a high degree of uncertainty, likely a factor of two based on professional judgment, due primarily to the uncertainty in the volume of waste released. However, less than 1 Ci of Cs-137 was released at Site CPP-15. Compared to other releases in the tank farm area (such as CPP-31 where approximately 17,000 Ci of Cs were released), Site CPP-15 contains insignificant quantities of fission products and should not affect groundwater models.

5.2.2 Cleanup

Contaminated soil outside the solvent burner building (CPP-629) was removed and placed in drums at the time of initial discovery in 1974. Uncontaminated soil was used to backfill the excavation.

Demolition of the solvent burner building in 1983 included removal of the furnace/burner unit; the furnace duct; the control shed; the piping, valves, and controls within the shed; the piping penetrating the shed; the solvent feed tank (LE-102); and the contaminated soil in the area (Figures 5-3 and 5-4).

Interviews with personnel involved in the demolition indicated that the soil excavation exceeded 10 ft below grade and was very thorough. No postexcavation sampling was performed to confirm the removal of contamination. Site CPP-15 was originally included in OU 3-08, which underwent a Track 2 investigation (WINCO 1993). The Track 2 investigation was performed on the basis of information about the demolition and removal activities. Sampling and analysis were not performed. CPP-15 was recommended for No Further Action.

Table 5-10. Estimate of major radionuclides and nitrate released at CPP-15 in 1,000 L each of organic and stack condensate wastes.

	Cs-137	Sr-90	H-3	Tc-99	I-129	NO ₃
Organic	7.0E-06 Ci	6.0E-06 Ci	0	1.1E-06 mCi	3 µCi	0
Stack condensate	0.15 Ci	0.15 Ci	0.12 mCi	0.024 mCi	0.033 µCi	1.2 kg
Total released	0.15 Ci	0.15 Ci	0.12 mCi	0.024 mCi	3 µCi	1.2 kg

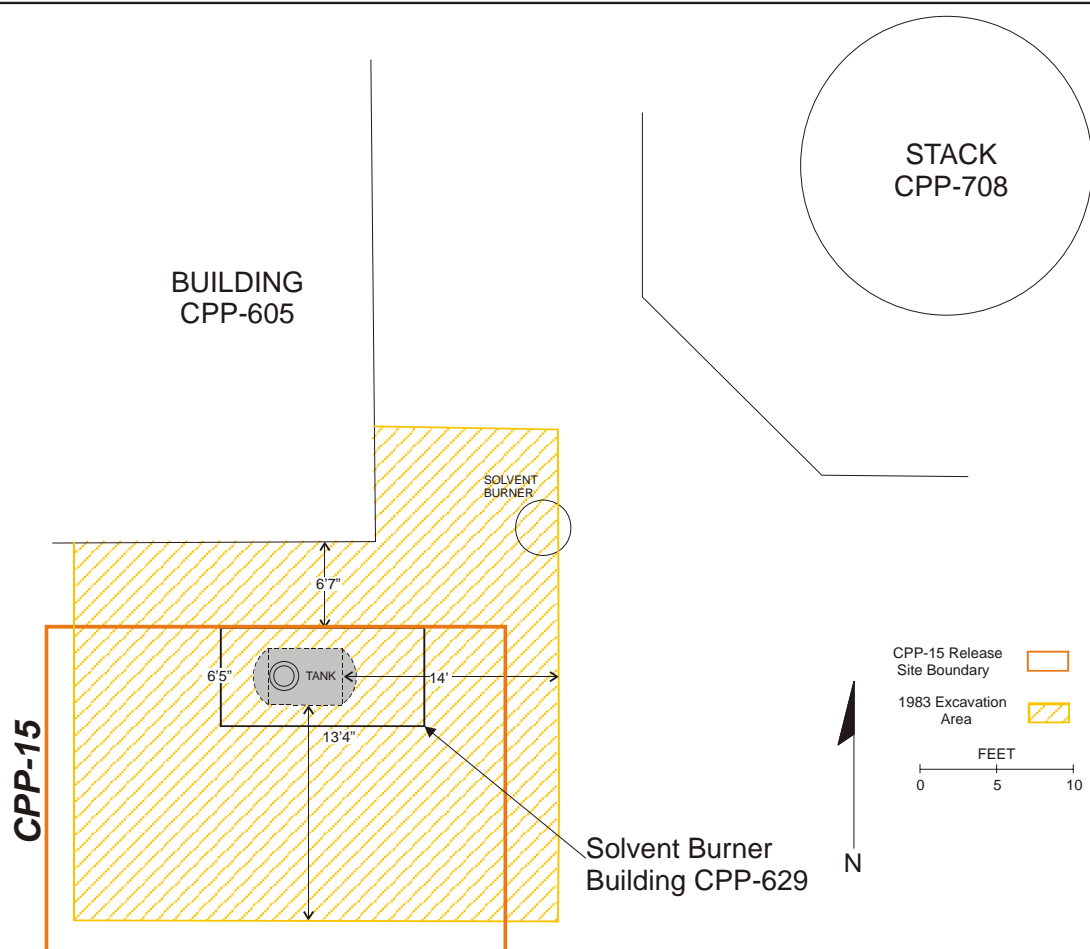


Figure 5-3. Site CPP-15 location map.

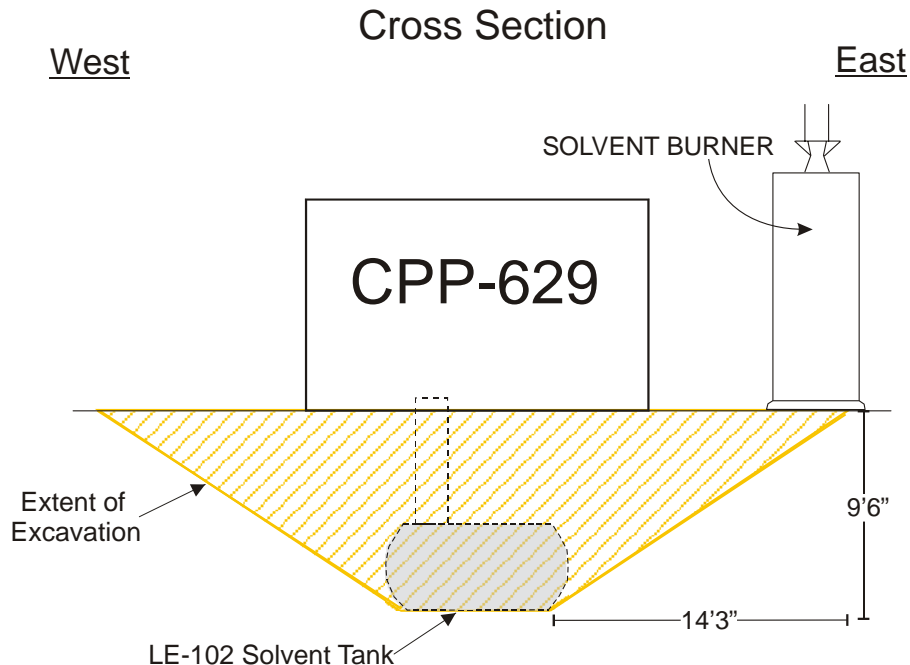


Figure 5-4. Cross section showing the general shape of the 1983 excavation to remove solvent tank.

During excavation on September 6, 1995, to install a transformer pad and electrical duct banks over CPP-15, construction crews encountered contaminated alluvium at a depth of 2 ft and a concrete footing, which was a remnant of the old stack preheater. One spot on the concrete footing beneath the contaminated soil had a reading of 1.5 R/hr. The alluvium near and under the footing was sampled on September 11, 1995. The INTEC CERCLA representative, who was dealing with all contamination encountered at CERCLA sites, instructed the construction crew to remove contaminated alluvium in the site by excavating down to a depth of 10 ft or until the clean alluvium was encountered, whichever came first. He determined that it would be easier to clean up the site during the upgrade project before the electrical duct banks and transformer pad were built over the site.^a The excavation was 11 ft wide, 17 ft long, and varied in depth from 4 to 10 ft. Construction records and field logs indicate that 39 boxes of contaminated alluvium and the concrete footing were removed from the site over the next 2 months. Soil that was uncontaminated based upon field screening was stockpiled and used as backfill. This information is confirmed by the low radionuclide activity (consistent with backfill) in the 2004 soil samples from the near-surface locations and the high levels of radiological contamination encountered below approximately 10 ft (9.9-11.3 ft below grade level).

5.2.3 Previous Investigations

In 1995, five alluvium samples were collected in the area of the contaminated footing from the following locations:

- A stockpile of soil excavated from 0 to 3 ft below grade that was in a dump truck (Sample ECA-15-1, also reported as Sample 1R)

a. Dennis Raunig, CH2M-WG Idaho, LLC, personal communication to Lorie Cahn, CH2M-WG Idaho, LLC, September 22, 2005, Idaho Falls, Idaho.

- Soil approximately 1.5 ft away from the footing at 2 ft below grade (Sample ECA-15-2 or 2R)
- Soil directly below the footing (Samples ECA-15-3 or 3R, and duplicate ECA-15-5 or 5R)
- Soil 4 ft below the footing, 6 ft below land surface (Sample ECA-15-4 or 4R).

In 1996, when the excavation was completed, an additional sample was collected:

- Soil 8.5 ft below the footing, 10.5 ft below land surface (Sample CPP-15-4-D) at the bottom of the excavation.

The locations where the soil samples were collected are shown on Figure 5-2. Analytical results of the six samples are presented in Table 5-11. Construction records, field logs, and conversations with workers and subcontractors indicate that the contaminated soil was removed and boxed until clean alluvium was found in the excavation or to a 10-ft depth.

The 1995/1996 soil sampling analytical results indicate that the highest levels of radionuclide contamination were present in the samples collected 8.5 ft below the contaminated footer, which is 10.5 ft below grade. This would suggest that not all of the contaminated soil was removed during the 1983 demolition activities and is consistent with the report that the excavation extended only to 10 ft below grade. Cs-137 was the only radionuclide detected in the four shallow soil samples during an analysis for gamma-emitting radionuclides. The detected concentrations ranged from $2,350 \pm 120$ to $43,400 \pm 1,800$ pCi/g. In addition to gamma spectroscopy analysis, the samples were analyzed for a suite of other radionuclides, including I-129, Np-237, total strontium, Tc-99, plutonium, and uranium isotopes. The Cs-137 activity in the deep sample was $586,000 \pm 17,000$ pCi/g. Other radionuclides detected in the deep sample were Am-241 at 538 ± 35 pCi/g, Eu-154 at 243 ± 24 pCi/g, Np-237 at 0.63 pCi/g, Pu-238 at $4,570 \pm 320$ pCi/g, Pu-239/240 at 825 ± 63 pCi/g, Tc-99 at 36.7 pCi/g, and U-235 at 0.0203 pCi/g. I-129 was not detected.

All of the soil samples were analyzed for metals, cyanide, sodium, potassium, SVOCs, percent solids, and VOCs as well. Zirconium was detected in all five samples and the duplicate at concentrations ranging from 5.13 to 13.97 mg/kg. Thallium was detected in the sample at 4.85 mg/kg from 2 ft below grade. The reported results for all other metals in the samples were consistent with background soil concentrations of the metals at the INL Site. In the organic analysis, methylene chloride was detected in all of the samples at very low concentrations (less than 0.01 mg/kg). It was also detected in the method blanks. Trichloroethene was detected in the sample of soil from the dump truck at an estimated concentration of 4.6 µg/kg.

The SVOC analysis of the soil samples indicates the presence of a number of SVOCs that would be expected at the site, given the site history. These SVOCs included TBP and some polyaromatic hydrocarbons, which are associated with combustion of kerosene. Some SVOCs were spectrally present but below the sample quantitation limit and flagged U. These include tri-n-butyl phosphate, acenaphthene, phenanthrene, anthracene, fluoranthene, benzo(k)fluoranthene, and benzo(b)fluoranthene. Many of the samples had detectable concentrations of 3-nitroaniline, azobenzene, 2-methylphenol, bis(2-chlorethyl)ether, 2,6-dinitrotoluene, and numerous tentatively identified compounds. A number of other compounds, including naphthalene, 2-methylnaphthalene, 2-chloronaphthalene, acenaphthylene, dimethylphthalate, dibenzofuran, fluorene, diethylphthalate, carbazole, di-n-butylphthalate, bis(2-ethylhexyl)phthalate, butylbenzylphthalate, and di-n-octylphthalate, were reported present in both the samples and the reagent blank.

Table 5-11. Analytical results for soil samples collected during the 1995 construction activities at CPP-15 (DOE-ID 1997).

Sample Number	Sample Depth (ft)	Am-241 (pCi/g)	Cs-137 (pCi/g)	Sr-90 (pCi/g)	Eu-154 (pCi/g)	Np-237 (pCi/g)	Pu-238 (pCi/g)	Pu-239/240 (pCi/g)	Tc-99 (pCi/g)	U-233 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)
Samples from alluvium that was excavated in 1995														
ECA-15-1	0 – 3 (excavated soil composite) ^a	ND	44.5 ± 7.7	16.4	NA	ND	0.57 ± 0.16	ND	7.41	23.5	0.02	0.26	ND	84.7
ECA-15-2	2	3.42 ± 0.42	2,810 ± 140	727	NA	ND	22.7 ± 1.6	4.30 ± 0.50	7.24	47.9	0.03	0.36	84	3,500
ECA-15-3	2	2.42 ± 0.42	2,350 ± 120	617	NA	ND	19.6 ± 1.3	3.44 ± 0.38	4.15	243	0.06	0.28	75.9	2,970
ECA-15-5 (dup)	2	15.8 ± 1.6	43,400 ± 1,800	4,250	NA	ND	93.3 ± 4.6	16.9 ± 1.2	5.89	18.2	0.01	0.29	1,090	48,100
ECA-15-4	6	19.6 ± 1.9	15,420 ± 850	7,990	NA	0.47 ± 0.12	112 ± 5.4	19.8 ± 1.3	6.17	23.7	0.02	0.31	462	27,700
Samples from alluvium that remains in place (taken in February 1996)														
CPP-15-4-D	10.5	538 ± 35	586,000 ± 17,000	DNF	243 ± 24	0.63	4,570 ± 320	825 ± 63	36.7	DNF	0.0203	DNF	5,680	778,000
a. Sample composited from excavated soil in dump truck. Note: The following radionuclides were analyzed for but not detected at the site: Co-60, Cs-134, I-129, Ru-103, Ru-106, U-234, U-236. ND = not detected. NA = not analyzed. DNF = data not found.														

5.2.4 OU 3-14 Investigation

5.2.4.1 Scope. The OU 3-14 field investigation was focused on resolving remaining data gaps for CPP-15 described below. Details of the OU 3-14 field investigation at CPP-15 are provided in Appendix H. These include

- Sample collection procedures
- Sample documentation, custody, handling, and transportation
- Analytical methods
- Data reporting
- Quality control.

Details of the location and installation of gamma logging probeholes and sampling coreholes are provided in Appendix F.

5.2.4.2 DQOs. DQOs for the OU 3-14 field investigation for CPP-15 are summarized in Table D-1 of DOE-ID (2004). The extent, distribution, composition, and properties of contamination were not adequately known to resolve Decision Statements 1-3.

The field investigation strategy formulated to obtain the decision inputs needed to resolve the decision statements included

- Two angle-pushed coreholes at the east end of the transformer pad and gamma logging to establish vertical extent at approximate location of hotspot
- One vertically pushed corehole at the east end to establish areal extent to the east
- Sampling and analysis for the COPCs listed in Table 5-6; archiving of excess sample material for possible subsequent soil/water partition coefficient (K_d) or treatability studies.

Probehole installation is described in Appendix F. Samples were collected in 4-ft intervals in core barrels using GeoProbe direct-push tooling and analyzed for the constituent list shown in Table 5-6. Results are summarized in Table 5-12 below and are provided in total in Appendix G. Casing was installed and the hole was gamma-logged using the AMP-50. Gamma readings for each depth interval are listed in Appendix F, Table D-1.

5.2.4.3 Probing and Gamma Logging Investigation. Probehole installation is described in Appendix F. Probeholes 15-1 (CPP-1866) and 15-2 (CPP-1867) were pushed at the locations shown on Figure 5-2 at an angle of 45 degrees from the vertical and at an azimuth of 270 degrees (trending due west). Twenty-nine feet of casing were pushed at an angle of 45 degrees, resulting in vertical and horizontal distances of 20.6 ft. Probehole 15-3 (CPP-1868) was pushed vertically 45 ft to basalt.

Probeholes 15-1, 15-2, and 15-3 were gamma-logged using both the AMP-50 and AMP-100. Gamma-logging results are shown in Table D-1 of Appendix F and discussed below.

Table 5-12. OU 3-14 field investigation sampling and analysis results for 15 sample (CPP-1869).

Depth (ft)	Cs-137 (pCi/g)	Sr-90 (pCi/g)	Pu-238 (pCi/g)	Pu-239/240 (pCi/g)	I-129 (pCi/g)	Tc-99 (pCi/g)	Am-241 (pCi/g)	Eu-154 (pCi/g)	U-233/234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Np-237 (pCi/g)	H-3 (pCi/g)	As (mg/kg)	Cr (mg/kg)	Hg (mg/kg)	Nitrate-N (mg/kg)	pH	Acetone (µg/kg)
1.4-2.8	59	27	0 ^a	0	ND ^b	ND	0	ND	1	0	1	ND	ND	9.54	28.3	0.10	4	9.1	103
4.2-5.7	90	12	0	0	ND	4	0	ND	1	0	1	ND	ND	10.3	21.6	0.10	3	9.1	ND
7.5-8.5	85	21	0	0	ND	11	0	0	1	0	0	0	ND	14.3	25	0.07	4	9.2	10.8
9.9-11.3	47,000	7,180	1,080	213	ND	15	187	39	99	ND	ND	2	ND	5.43	21	0.53	4	8.8	60.5
11.3-12.7	5,830	13,900	83	18	ND	26	37	56	3	ND	ND	1	ND	10	34.6	0.59	3	8.9	29.1

a. 0 = detected at very low levels (decimal places not shown).
b. ND = nondetect (U) and false positive (UJ).
Note: Uncertainty detection limits are not shown. See Appendix G for analytical tables.

Samples were collected from Probehole 15-Sample (CPP-1869) in 4-ft intervals in core barrels using GeoProbe direct-push tooling and analyzed for the constituent list shown in Table 5-6. Results are discussed below and are provided in total in Appendix G.

5.2.4.4 Results. OU 3-14 field investigation sampling results are summarized in Table 5-12 and in Appendix F, Table D-1, respectively. Table 5-12 includes only a subset of analytical results and does not include laboratory or validation flags, sampling errors, or method detection limits; “ND” represents compounds that were U or UJ flagged; and “0” represents compounds detected at low levels but the decimal places are not shown. Complete detailed sampling results are provided in Appendix G.

Maximum gamma readings of 16 mR/h at 10.36 ft bgs (vertical depth) and 2 mR/h at 9.62 ft bgs were observed in angle probeholes 15-1 and 15-2, respectively. A maximum gamma reading of 1 mR/h was observed in vertical probehole 15-3 at 9.45 ft bgs.

Sampling results for 15-sample (CPP-1869), pushed adjacent to 15-1 (CPP-1866), indicate relatively high levels of contamination below about 10 ft bgs, with a maximum of 47,000 pCi/g Cs-137 at 9.90-11.32 ft bgs. Maximum Sr-90 results are 13,900 pCi/g in the 11.32- to 12.73-ft bgs interval. Other radionuclides and maximum concentrations detected in the 9.9- to 12.7-ft bgs interval include Pu-238 (1,080 pCi/g), Pu-239/240 (213 pCi/g), Tc-99 (26 pCi/g), Am-241 (187 pCi/g), Eu-154 (56 pCi/g), and U-233/234 (99 pCi/g).

5.2.5 Contamination Remaining in Alluvium

This section summarizes results of all investigations and process knowledge of the release at CPP-15 in the context of

- Nature of contamination, including ranges of contaminant concentrations observed
- Areal and vertical extent of contamination remaining in the alluvium
- Volume of contaminated alluvium present.

5.2.5.1 Nature of Contamination. Contamination observed in previous investigations, including the OU 3-14 field investigation, is consistent with the conceptual model of the release and the source term described previously. As described previously, the relatively high Cs-137 and low Pu radionuclide activities are not consistent with the organic waste source term given above, supporting the hypothesis that both solvent extraction and stack condensate waste types were released.

Acetone was the only INTEC liquid waste system listed RCRA constituent cited in INEEL (1999) analyzed for that was detected; it was detected at a maximum concentration of 103 µg/kg.

5.2.5.2 Vertical Extent. Relatively low levels of contamination consistent with use of slightly contaminated backfill as discussed in Section 5.18 for CPP-96 extend to at least 10 ft bgs at this site. These data, along with construction records, field logs, and conversations with workers and subcontractors, confirm that the site was excavated most recently in 1995 to a depth of approximately 10 ft. Higher contaminant concentrations remain below about 10 ft bgs based on contaminant concentrations observed in Probehole 15-Sample and CPP-15-4-D. Concentrations decline below 12.7 ft bgs.

5.2.5.3 Areal Extent. Areal extent of contamination is conservatively estimated as the area indicated by the release site boundary as shown on Figure 5-2. The extent is bounded on the east by Probehole 15-3, on the north by CPP-605, and on the south and west by previous excavations.

5.2.5.4 Remaining Curies. The majority of the contamination released to soil at CPP-15 was removed shortly after the release and during the removal of the solvent burner and organic storage tank in the mid-1980s. Additional contaminated alluvium and an old concrete footing were removed in 1995. Evidence for these cleanups is shown by the low radionuclide activity (consistent with slightly contaminated backfill) in the 2004 soil samples from the 0- to 10-ft bgs interval. However, based on the 1996 and 2004 soil sampling results, not all of the contamination below 10 ft bgs was removed during 1983 demolition. The low levels of Cs-137 in the shallow soil samples are indicative of contaminated backfill. The high Cs-137 concentration at the 10.5-ft depth is consistent with the overflow of solvent caused by the stack condensate.

Less than 1 Ci of Cs-137 was released at Site CPP-15. The total amount of contamination remaining in the alluvium is unknown but is estimated to be a relatively small fraction of the total released. Compared to other releases in the tank farm area (such as CPP-31 where approximately 17,000 Ci of Cs were released), Site CPP-15 contains insignificant quantities of fission products and should not affect groundwater models. Sampling results do not indicate that significant amounts of activity reached basalt.

5.2.6 Uncertainties/Data Gaps

No significant data gaps remain for this site. The extent, distribution, and composition of contamination originally released and remaining are adequately known to complete the BRA. Table 5-13 summarizes resolution of data gaps for CPP-15.

Table 5-13. Summary of data gaps for Site CPP-15.

Decision Statements	Extent Known Adequately to Resolve Decision Statement?	Distribution Known Adequately to Resolve Decision Statement?	Composition Known Adequately to Resolve Decision Statement?	Properties ^a Known Adequately to Resolve Decision Statement?
1. Determine whether or not soil exposure risks to future workers at CPP-15 exceed allowable levels, requiring control of the exposure pathway.	Yes. Contamination in the 0 to 4-ft interval adequately defined.	Yes.	Yes. Contaminant composition consistent with conceptual model of release.	Properties information is not needed to resolve Decision Statement 1.
2. Determine whether or not contaminants are transported out of the tank farm soils to the Snake River Plain Aquifer (SRPA) at rates sufficient to result in COPC concentrations exceeding allowable levels at the exposure point, requiring control of the exposure pathway.	Yes. Source term conservatively estimated.	Yes.	Yes. Contaminant composition consistent with conceptual model of release.	Yes.

Table 5-13. (continued).

Decision Statements	Extent Known Adequately to Resolve Decision Statement?	Distribution Known Adequately to Resolve Decision Statement?	Composition Known Adequately to Resolve Decision Statement?	Properties ^a Known Adequately to Resolve Decision Statement?
3. Determine whether or not a remedial action that includes [GRA] ^b best meets FS evaluation criteria to mitigate excess risks, relative to other alternatives.	Yes.	Yes.	Yes. Contaminant composition consistent with conceptual model of release.	Yes.

a. Properties refer to (a) physicochemical parameters for fate and transport modeling of groundwater contamination source term and (b) parameters needed to evaluate in situ or ex situ treatment for release sites that present significant risks to groundwater. Knowledge of properties is not needed for sites that do not pose significant groundwater risks based on the estimated fractional radionuclide mass present.
b. General Response Actions (GRAs) to be evaluated include No Action; Institutional Controls; Containment (including capping); Treatment (in situ and ex situ); Retrieval; and Disposal.

5.2.7 References

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- DOE-ID, 2004, *Operable Unit 3-14 Tank Farm Soil and Groundwater Remedial Investigation/ Feasibility Study Work Plan*, DOE/ID-10676, Rev. 1, U.S. Department of Energy Idaho Operations Office, June 2004.
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- INEEL, 1999, *A Regulatory Analysis and Reassessment of U.S. Environmental Protection Agency Listed Hazardous Waste Numbers for Applicability to the INTEC Liquid Waste System*, INEEL/EXT-98-01213, Rev. 1, Idaho National Engineering and Environmental Laboratory, February 1999.
- Lohse, G. E., 1974, “Overflow of Solvent Burner Feed Tank,” Significant Operating Occurrence Report 74-10, Allied Chemical Corporation, April 1974.
- Staiger, M. D., 1974, “Seepage of Contaminated Solution from CPP Main Stack,” Significant Operating Occurrence Report 74-31, Allied Chemical Corporation, November 1974.
- Wenzel, D. R., 2004, “Assessment of Radioactivity in INTEC Soil Contamination Site CPP-28,” EDF-5318, Rev. 0, Idaho Completion Project, Idaho National Engineering and Environmental Laboratory, November 2004.
- WINCO, 1993, *Final Track 2 Summary Report for Operable Unit 3-08 (Tank Farm Area II)*, Rev. 3, Westinghouse Idaho Nuclear Company, July 1993.

5.3 CPP-16

Site CPP-16 (see Figure 1-2) is located a few yards north of Building CPP-712, centered on Valve Box C-8.

5.3.1 Description of Release

Site CPP-16 was contaminated in January 1976 when a valve on a waste transfer line between Tanks WM-181 and WL-102 leaked (Figure 5-5). The leaking waste entered the soil because the valve was located in a gravel-bottomed manhole, instead of a stainless-steel-lined valve box that was typical of most tank farm valve boxes. An Operating Occurrence Report (Allied Chemical 1976) describes the leak and associated corrective actions taken at the time of the event.

5.3.1.1 Background of System Configuration and Leak. The INTEC service waste system collects wastewater, such as steam condensate (from process and building heating systems), cooling water, and boiler house wastewater, and disposes it to the environment. With the exception of the PEW evaporator condensate, the service waste system was designed to be radiologically noncontaminated during normal operation. However, the water could become contaminated due to an equipment failure, such as the failure of a heating or cooling coil in a vessel containing contaminated solution. Contamination could enter the service waste system via the failed heating or cooling coil. The original INTEC design included a service waste monitoring system that collected wastewater samples for analysis to assure effluent releases were within applicable radiological and chemical disposal limits. The monitoring system was designed to detect a release of radioactivity but could not stop the release. In the early 1970s, the service waste monitoring system was upgraded with the addition of a diversion system. The diversion system could send contaminated wastewater to a collection tank if the monitoring system detected above-normal activity and prevent the release of activity above applicable limits.

The initial diversion system used Tank WM-181 as the collection tank for diverted waste. WM-181 had been used to store concentrated PEW evaporator bottoms and second- and third-cycle waste (called SBW today). In order to empty WM-181 and convert it into the service waste diversion system collection tank, its contents were transferred to WM-180 in November 1972 (resulting in the CPP-31 contamination). Necessary pumps and piping were also installed to send potentially contaminated service waste water to WM-181. The new diversion system was placed in service in April 1973. Over the next several months, WM-181 slowly filled with waste, primarily from occasional diversions of the service waste water system. The service waste diversions were false alarms, caused by electronic noise and errant spikes in the radioactivity detection instrumentation, not by above-normal activity in the wastewater. However, because WM-181 had previously been used to store radioactive waste, service waste water diverted to WM-181 became contaminated with the residue in WM-181 and could not be returned to the service waste system. The diverted service waste water in WM-181 was treated as dilute radioactive waste and concentrated in the PEW evaporator.

In order to send the waste in WM-181 to the PEW evaporator, a new waste transfer line was installed connecting the WM-181 discharge system with the PEW evaporator feed collection tank, WL-102. The new line joined an existing transfer line that had originally been designed to send the closed-loop, tank farm cooling water to the PEW evaporator, if the cooling water ever became contaminated. Because it was intended for emergency use (in the event a cooling coil breached and the cooling water became contaminated), the line was not designed with the leak containment typical of other tank farm waste handling systems. The new waste transfer line joined the cooling water line in a concrete manhole equipped with a gravel bottom, not a stainless-steel-lined valve box typical of other tank farm waste transfer piping.

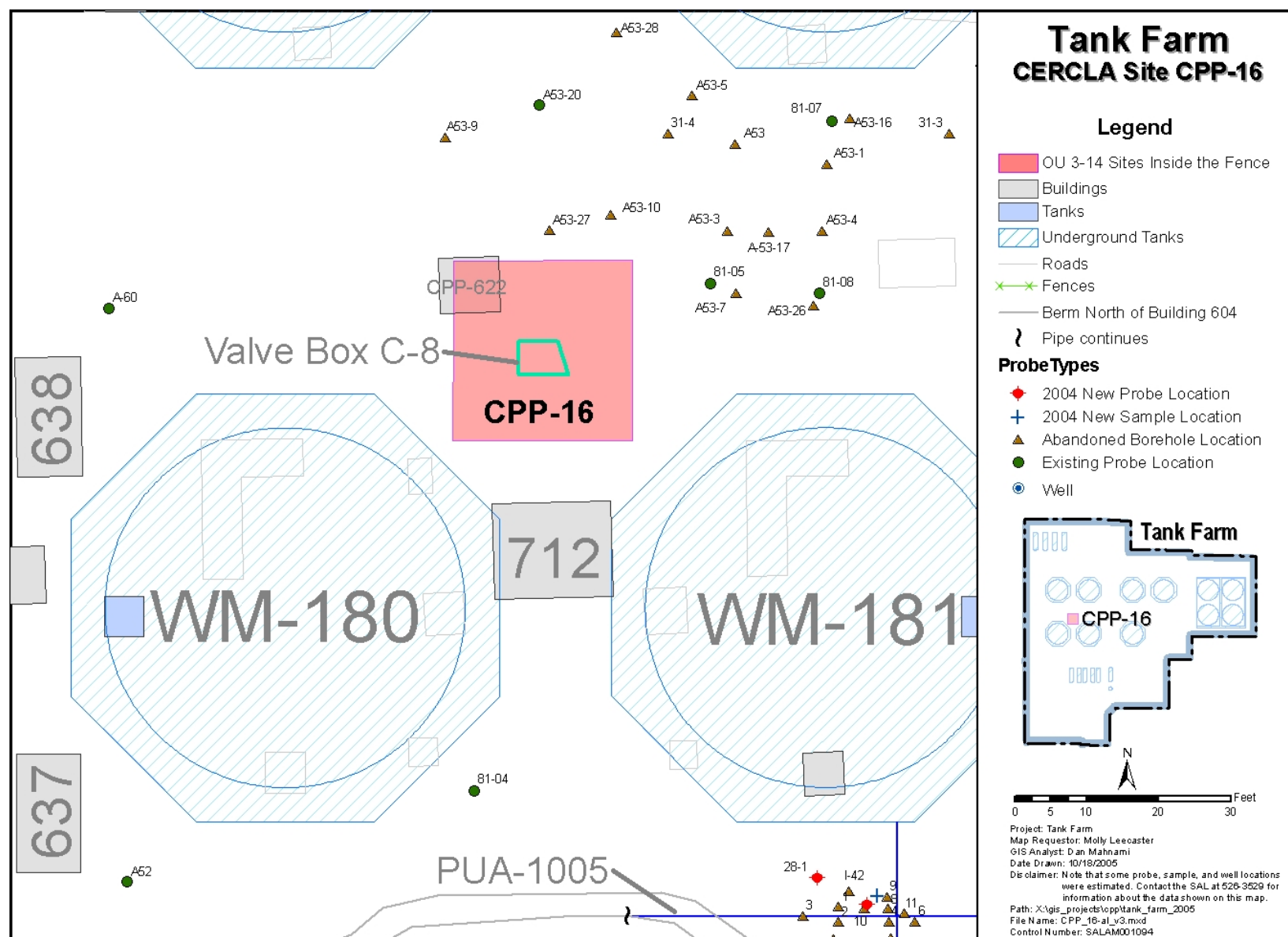


Figure 5-5. Detailed map of CPP-16.

Because WM-181 was large and the number of service waste diversions and volume of water diverted were relatively small, WM-181 filled slowly. Consequently, transfers from WM-181 to WL-102 were infrequent. The first WM-181-to-WL-102 transfer occurred as the waste volume in the WM-181 neared 100,000 gal in April 1975, two years after WM-181 was converted into the service waste diversion tank. During April and May 1975, several small transfers were made from WM-181 to WL-102 in order to minimize the waste volume in WM-181. No leaks were noted during those transfers. The next use of the line was January 9, 1976, when the waste volume in WM-180 approached 100,000 gal again. The tank farm engineer's log indicated the concrete manhole was inspected but no liquid leaks were seen during that transfer. Additional waste transfers were made on January 11, 14, and 16, 1976. A leak was observed in the concrete manhole on January 16, 1976. The leak was the result of a failed gasket on a flange of one of the valves on the waste transfer line.

Upon discovery of the leak, the waste transfer was immediately terminated, and the leaking valve repaired. The ground within the manhole was probed to determine the extent of the contamination. The highest radiation readings were from the first 2 ft of gravel and soil in the bottom of the manhole where the radiation readings ranged from 11 to 21 R/hr. After 2 ft of depth, the radiation readings dropped dramatically, to only 0.4 R/hr at 3 ft of depth. Soil samples taken at the time of the leak indicated the bulk of the gamma activity was Cs-137, with Cs-134 about 5% of the Cs-137, and Ce-144 about 2% of the Cs-137. This activity distribution is consistent with newly generated PEW evaporator concentrate, the primary source of the contamination. In 1976, the amount of activity released was estimated^b to have been 1.2 Ci. The basis for the calculation of a 1.2-Ci release is not readily available for review.

There is no record of any soil removal at the time of the incident. No changes to the valve box (other than repair of the valve) occurred immediately after the incident because a large tank farm upgrade project was already in design that included replacing the concrete manhole with a stainless-steel-lined valve box. The upgrade project was completed in 1977 and Valve Box C-8 was installed in place of the concrete manhole. Valve Box C-8 installation work likely removed most of the highly contaminated soil. Valve Box C-8 is in the same location as the concrete manhole but is deeper than the original manhole. Much of the soil contaminated in 1976 had to be excavated and removed to make room for Valve Box C-8 when it was installed in 1977. However, records detailing the amount of soil removed or radiation readings from the removed soil are not readily available.

5.3.1.2 Waste Source Term. Although the primary source of the waste in WM-181 was false diversions of the service waste system, a portion of the WM-181 waste was PEW evaporator concentrate. Even after converting WM-181 into the service waste diversion tank, PEW evaporator concentrate was occasionally sent to WM-181 due to valve failures elsewhere in the tank farm that prevented sending the waste to other tanks. As a result, WM-181 contained a mixture of about 5 volume percent PEW evaporator concentrate and 95% diverted service waste water when the leak occurred (Loos 2004). The PEW evaporator concentrate portion of the WM-181 waste provided the contamination at Site CPP-16. As noted in DOE-ID (2004), the diverted service waste water may have contained some contamination from the PEW evaporator condensate system, but the amount was trivial compared to the contribution from the evaporator concentrate (DOE-ID [2004] data show the service waste system contributed about one billionth of the total Cs-137).

There are no analytical data of the waste that leaked at Site CPP-16. However, the activity in the waste can be estimated from historical analyses of other similar wastes. WM-181 became a SBW storage tank again in April 1977 when a new service waste diversion collection tank (WM-191) was constructed.

b. G. E. Lohse, Internal Notegram dated July 6, 1976, documenting completion of an action to estimate the activity released in Operating Occurrence Report 76-3 (Site CPP-16).

WM-181 was refilled with SBW by 1981 and was sampled in 1983 (sample log 830624-4). The WM-181 waste sampled in 1983 was similar to the contaminated portion of the WM-181 waste (PEW evaporator concentrate) that leaked in 1976. The 1983 WM-181 sample had the following radionuclide activities:

- Cs-137 = 28.6 mCi/L (108 mCi/gal)
- Sr-90 = 21.5 mCi/L (81.4 mCi/gal)
- H-3 = 39.5 μ Ci/L (150 μ Ci/gal)
- Tc-99 = 4.58 μ Ci/L (17.3 μ Ci/gal) (calculated value, see explanation below)
- I-129 = 3.27 nCi/L (12.4 nCi/gal) (calculated value, see explanation below).

The Cs-137, Sr-90, and H-3 activities given came from the 1983 WM-181 waste sample analysis. The Tc-99 activity was calculated based upon fission yield and the activity of Cs-137 in the waste sample, and assuming the waste was about 7 years old. The I-129 activity was calculated assuming the bulk of the waste came from the PEW evaporator, where some of the I-129 and H-3 were lost due to volatilization. Assuming the waste was about 7 years old, the H-3 activity was about 43% of that expected from fission yield. Assuming the I-129 had the same activity reduction as H-3 in the PEW evaporator results in a calculated I-129 activity of 3.27 nCi/L. The 1983 WM-181 sample had an analytical I-129 activity of 11.2 nCi/L, which is reasonably close to the calculated value. The calculated I-129 activity is listed above because the measured I-129 activity in tank farm waste is often higher than the actual activity due to incomplete radionuclide separation and false positive detections in the analytical process.

The nitrate content of the 1983 WM-181 waste was 4.5 molar. This was likely similar to the portion of the WM-181 waste derived from PEW evaporator concentrate.

5.3.1.3 Waste Volume Leaked to Soil. The amount of waste that leaked is uncertain. No leakage was noted during the January 9, 1976, transfer, so it is reasonable to assume no leaks occurred before that time. Three waste transfers were made between January 11 and January 16, when the leak was discovered. The waste transfers were relatively small (1,000-3,000 gal), which limits the total volume that may have leaked to a relatively small amount. The transfers were made from a large-diameter tank (WM-181), which was not equipped with high-precision liquid-level measurement devices, thus the estimate of leakage is not very precise. DOE-ID (2004) assumed about 3,000 gal leaked. This estimate came from descriptions of Site CPP-16 in previous contaminated soils reports. The estimate was made by the tank farm engineer and received no review.

The bulk (95%) of the waste that leaked was noncontaminated service waste water. Assuming the contamination came from the equivalent of 150 gal of SBW (5% of 3,000 gal) yields the following calculated activities released to the soil: 16 Ci Cs-137, 12 Ci Sr-90, 22 mCi H-3, 2.6 mCi of Tc-99, and 1.9 μ Ci I-129. This amount of activity is similar to the estimate in DOE-ID (2004). However, this activity estimate is over an order of magnitude higher than the estimate of 1.2 Ci (total activity) made in 1976 as required by the Occurrence Report (Allied Chemical 1976). The difference is likely due to the volume of waste assumed to have leaked. A review of the historical data shows the 3,000-gal estimate was too high. If one assumes only 150 gal leaked (instead of 3,000 gal), then the calculated activity released is reduced by a factor of 20 and is very close to the 1976 estimate of activity released. The smaller release also matches available historical tank volume data better than the 3,000-gal release.

Of the four transfers made in January 1976 leading up to the leak, no leaks were observed during the first transfer. The waste volumes sent and received were approximately equal with the second transfer (no apparent leaks). The difference between the volumes sent and received was larger than normal during the third transfer (possible minor leak). The leak was discovered by visual observation during the fourth transfer. The historical data show the third and fourth transfers likely leaked. A leakage of 3,000 gal represents 100% of the waste sent on the third and fourth transfers combined. Assuming the system went from no leaks to 100% leakage is not plausible. The waste transfer data show the bulk of the waste transferred arrived in the waste-receiving tank during both transfers. The Incident Occurrence Report (Allied Chemical 1976) indicates the “amount of liquid lost cannot be determined” because the waste volume measurements “were well within the detection limits for WM-181.” The detection limit of the WM-181 instrumentation was a few hundred gallons (about 300). A leak of up to 300 gal could not have been detected by the tank volume measurements. However, a leak of several hundred gallons (certainly 3,000 gal) would have been within the instrument detection capability and would have been detected.

A review of the January 1976 data used to make the estimate of the 3,000-gal leak found an error in the one of the calculated waste volumes in the third waste transfer, which resulted in the high estimate of the volume leaked. It was based on a miscalculation of the recorded tank volume data. The error was confirmed by the responsible tank farm engineer involved at the time of the leak who made the original overestimate. A more accurate leak estimate is about 150 gal. The 1976 estimate of 1.2 Ci released was completed several months after the leak occurred, when sufficient time was available to carefully review the pertinent operating data. The review likely noted the error in the original leakage estimate, corrected it, and estimated the activity released (1.2 Ci) based on a revised volume. A release of 150 gal fits the historical data better than the estimate of 3,000 gal and results in an activity release much closer to the original estimate.

5.3.1.4 Source Term Summary. Site CPP-16 was contaminated on January 16, 1976, when waste leaked during a WM-181-to-WL-102 transfer. The waste was primarily noncontaminated service waste water, but it contained about 5% PEW evaporator concentrate. The leak occurred in an unlined, gravel-bottomed manhole, located south of CPP-712, with the contamination going directly into the tank farm soil. A review of historical data shows the leakage estimate of 3,000 gal used in DOE-ID (2004) is over an order of magnitude too high. It was based on a miscalculation of the recorded tank volume data. A more accurate leak estimate is about 150 gal. The estimate of activity released with a 150-gal leak yields a value much closer to the estimate made in 1976 as a part of the incident review. Table 5-14 shows the contaminants released to Site CPP-16 assuming a 150-gal release containing 5% PEW evaporator concentrate (the equivalent of 7.5 gal of concentrated PEW evaporator concentrate). Table 5-14 does not consider any soil removal that occurred a year following the release when Valve Box C-8 was installed in the contaminated area. The amount of activity released at CPP-16 is small compared to that of other contaminated tank farm sites, such as CPP-31. Approximately 17,000 Ci of Cs-137 were released at Site CPP-31. This is over four orders of magnitude higher than the activity released at CPP-16 (assuming a 200-gal leak). Because the CPP-16 activity is a small part of the total tank farm source term, further detailed source term development is not recommended.

Table 5-14. Estimate of radionuclides and nitrate released at Site CPP-16.

Cs-137	Sr-90	H-3	Tc-99	I-129	NO ₃
0.81 Ci	0.61 Ci	1.1 mCi	0.13 mCi	0.093 µCi	7.9 kg

5.3.2 Cleanup

The manhole was replaced during the ICPP Radioactive Liquid Waste System Improvement project in 1977 with Valve Box C-8. The new valve box had a stainless-steel-lined concrete floor and sump that extends 6 ft 9 in. bgs. The original lines leading to the old manhole were maintained with the exception of the line originating from WM-181. Since WM-181 was no longer needed for storage of diverted service waste, the line coming into the original manhole was cut and capped. Specifics about what was encountered during the construction activities—that is, how much soil was removed or how much remains—are unknown. Records detailing the amount of soil removed or radiation readings from the removed soil are not available; however, much of the soil contaminated in 1976 had to be excavated and removed to make room for Valve Box C-8 in 1977. Anecdotal information indicates that contaminated soil was used for backfill in the 1977 tank farm upgrade project. The exact location of contaminated backfill and whether it was used at this site is unknown. CPP-96 accounts for the reuse of contaminated soil in the tank farm.

Site CPP-16 was originally included in OU 3-07, which underwent a Track 2 investigation in 1992 (WINCO 1993). The Track 2 was performed on the basis of the information available, and CPP-16 was recommended for No Further Action based on the depth of the contamination (WINCO 1993; DOE-ID 1994). Site CPP-16 is being reinvestigated because consolidation of all tank farm soil and sites within CPP-96 subject CPP-16 to OU 3-14 RI/FS activities.

5.3.3 Previous Investigations

A 1-in. Schedule 40 carbon-steel pipe was driven 3 ft into the soil on the north side of the piping at the time of discovery in 1976 to determine the depth of contamination. Thermoluminescent dosimetry (TLD) chips were lowered into the pipe and found radiation readings ranging from 0.4 R/hr at the bottom of the pipe to 21.4 R/hr at the 1.0-ft depth. The pipe was then driven 2 ft deeper and additional readings were collected. These additional readings were as follows:

- 0 ft - 9.66 R/hr
- 1 ft - 19.2 R/hr
- 2 ft - 12.0 R/hr
- 3 ft - 0.33 R/hr
- 4 ft - 0.17 R/hr
- 5 ft - 0.15 R/hr.

These readings suggested that most of the contamination remained in the 3 ft of soil immediately below the manhole, or from the 5.7- to 8.7-ft depth interval measured from land surface. A gamma scan was performed on the soil sample collected from the bottom of the manhole and results are summarized in Table 5-15. The sample was collected for screening purposes; therefore, the data are only an indication of what gamma-emitting radionuclides were present at the release.

Table 5-15. Gamma scan results for a soil sample collected from the CPP-16 release site.

Sample	Ce-144 (pCi/g)	Co-60 (pCi/g)	Cs-134 (pCi/g)	Cs-137 (pCi/g)	Eu-154 (pCi/g)	Ru-106 (pCi/g)	Sb-125 (pCi/g)
Soil grab sample from the floor of the manhole	6.21	1.08	17.66	325.6	3.23	43.91	6.89

In reviewing the radiological data, the radionuclide concentrations measured in the soil sample appear to be relatively low in comparison to the radiation readings measured in the driven pipe. The location of the soil sample collection point was not documented. Based on the low radionuclide concentrations, the sample may have been collected in an area of the manhole that received very little of the leaking water and was not representative of the most contaminated soil. The downhole readings suggest that a significant portion of the contamination partitioned to the soil 3 ft below the bottom of the manhole.

5.3.4 Contamination Remaining in Alluvium

This section summarizes results of all investigations and process knowledge of the release at CPP-16 in the context of

- Nature of contamination including ranges of contaminant concentrations observed
- Areal and vertical extent of contamination remaining in the alluvium
- Volume of contaminated alluvium present.

5.3.4.1 Nature of contamination. Contamination observed in previous investigations is consistent with the conceptual model of the release and the source term described previously, i.e., a release of PEW evaporator concentrate. Any remaining contamination is likely the result of use of contaminated backfill during construction of Valve Box C-8. The fraction of the total estimated release inventory of about 1.5 Ci remaining in the alluvium is unknown but, based upon the suspected extent of removal and radioactive decay, it is less than half of the initial release.

5.3.4.2 Vertical Extent. The vertical extent of any remaining contamination at this site is entirely contained within CPP-96. Given the relatively small volume and the relatively shallow depth of the release, it is unlikely that contamination migrated extensively below the maximum depth probed in 1976 of 5 ft below the bottom of the manhole or about 8 ft bgs.

5.3.4.3 Areal Extent. The areal extent of contamination at this site is entirely contained within CPP-96. The areal extent of contamination originating from CPP-16 was likely less than 20 ft², given the typical dimensions of a manhole. The actual extent was more likely bounded by the extent of excavation and backfilling for Valve Box C-8, which is unknown.

5.3.4.4 Remaining Curies. The fraction of the total estimated release inventory of about 1.5 Ci remaining in the alluvium is unknown but, based upon the suspected extent of removal, a known composition of primarily Cs-137 and Sr-90, and known radioactive decay rates, the remaining activity is certainly less than one-half of that initially released.

5.3.5 Uncertainties/Data Gaps

No significant data gaps remain for this site. The extent, distribution, and composition of contamination originally released and remaining are adequately known to complete the BRA and FS.

5.3.6 References

Allied Chemical, 1976, "Waste Transfer Line Gasket Leak," Operating Occurrence Report 76-3, Allied Chemical Corporation, January 16, 1976.

DOE-ID, 1994, *Modification to Consent Order*, U.S. Department of Energy Idaho Operations Office, U.S. Environmental Protection Agency, Region 10; and Idaho Department of Health and Welfare, March 17, 1994.

DOE-ID, 2004, *Operable Unit 3-14 Tank Farm Soil and Groundwater Remedial Investigation/ Feasibility Study Work Plan*, DOE/ID-10676, Rev. 1, U.S. Department of Energy Idaho Operations Office, June 2004.

Loos, R. L., Bechtel BWXT Idaho, to F. C. Holmes, DOE Idaho, January 29, 2004, "INTEC Tank Farm Operating History Report (INTEC-WP-03-021) and Completion of Sodium-Bearing Waste Treatment Process Project Milestone," CCN 47582.

WINCO, 1993, *Track 2 Summary Report for Operable Unit 3-07 (Tank Farm Area I)*, Rev. 2, Westinghouse Idaho Nuclear Company, May 1993.

5.4 CPP-20

Site CPP-20 (see Figure 1-2 and Figure 5-6) is located upon the berm north of CPP-604, near the northeast corner of the CPP-604 penthouse.

5.4.1 Description of Release

The contamination at Site CPP-20 was the result of several small leaks of very low-level-activity waste from temporary hose connections used with a tank truck unloading station. The leaks occurred over a period of several years when piping in the area was used to transfer waste from tank trucks into the PEW evaporator feed system.

5.4.1.1 Background of System Configuration and Leak. For many years, various sites around the INL Site, including the Reactor Technology Complex (RTC) (formerly Test Reactor Area [TRA]), Test Area North (TAN), Critical Infrastructure Test Range Complex (formerly Power Burst Facility [PBF]), etc., generated relatively small quantities of dilute, low-activity waste. It was not economically practical for each site to have its own dilute waste treatment facility for small amounts of waste. Instead, the waste was shipped by tank truck to INTEC where it was concentrated in the PEW evaporator feed system. Historically, INTEC received and processed approximately one 5,000-gal tank truck per month from other INL sites.

Until 1978, the non-INTEC waste was delivered to the PEW evaporator feed system via a waste unloading station located on the berm north of CPP-604, where a set of aboveground pipe stubs were located. The pipe stubs led to the CPP-604 waste storage tanks, WL-101, WL-102, WM-100, WM-101, and WM-102. WL-102 was the PEW evaporator feed collection tank. The contents of the tank trucks were transferred from the tank truck via a temporary hose to the aboveground pipe stub that led to WL-102. Typically, drip pans and blotter paper were used to contain any leakage from the hoses and piping connections. However, despite the precautions, some leaks to the soil occurred.

The number of leaks and amount of waste leaked are not known. The leaks were usually small, such as drips from leaking hose connections or from the hose when it was disconnected and removed. Typically, waste unloading operations were performed by INTEC operators and monitored by health physics (HP) technicians. The HP technicians conducted radiological surveys and directed the cleanup of any spills that occurred. The entire operation was done above ground where it could be easily monitored. The operation could be terminated immediately if a leak occurred. Thus, large unknown leaks could not have occurred and any drips or spill were likely immediately cleaned.

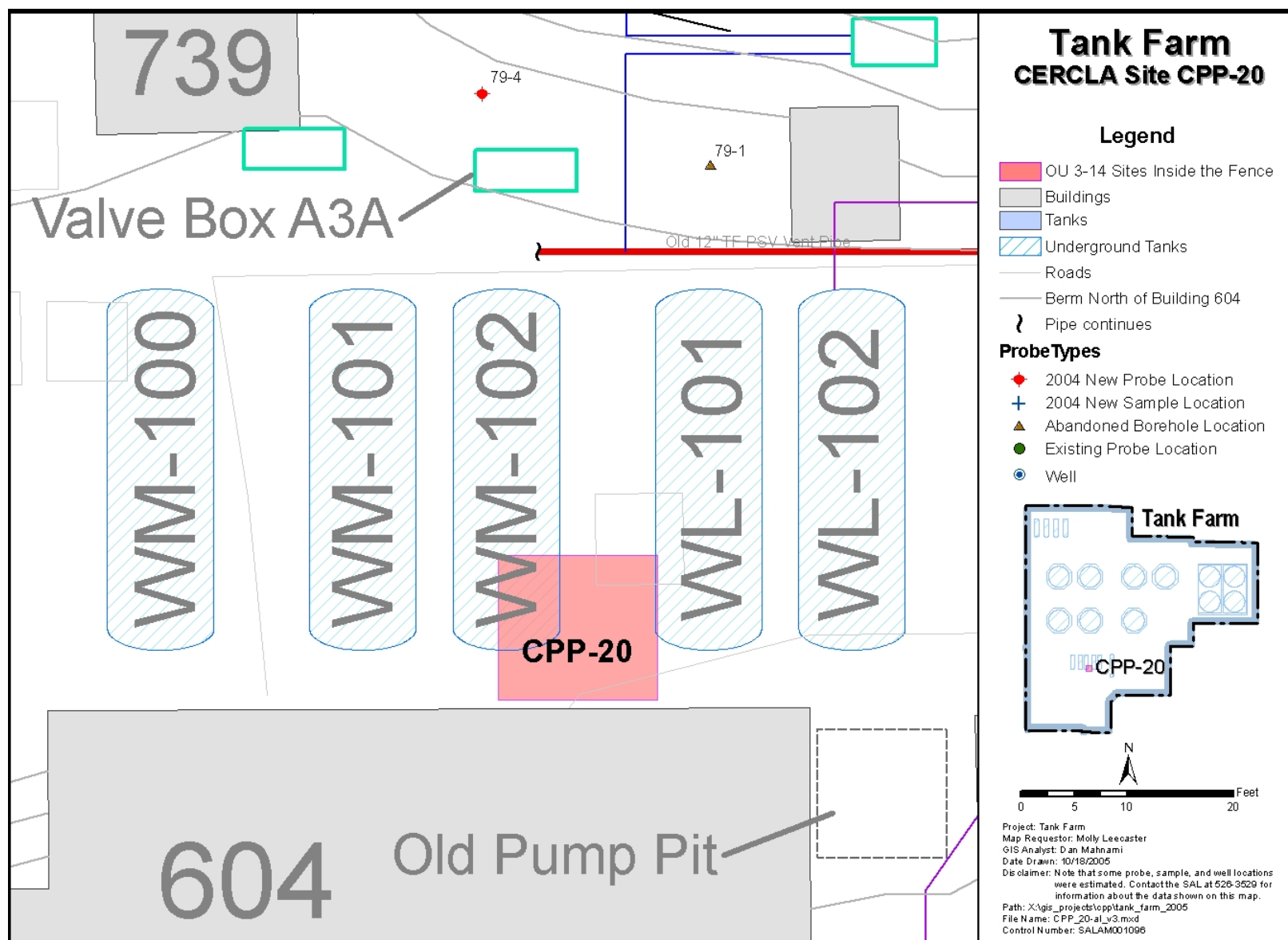


Figure 5-6. Site CPP-20 detailed map.

The waste trucked to INTEC contained very low levels of radioactivity. Leaks would have generated very low levels of contamination. The entire waste unloading area was excavated in the early 1980s with the projects that installed new waste transfer lines from CPP-601 to CPP-604 and Valve Box C-32, and waste tanks WL-132 and -133. Therefore, none of the original CPP-20 contamination exists at the original contamination site.

5.4.1.2 Waste Source Term. There are no compiled records of the amounts and activity of the waste that leaked at the truck unloading station. Typically, the waste was sampled to ensure it met INTEC PEW evaporator acceptance criteria prior to unloading the waste. A radiological source term for the leaked wastes can be estimated from historical sample data. Historical waste samples generally had Cs-137 activity of 100 to 1,000 d/s/mL. Swenson (1984) reviewed historical PEW evaporator feed sample activity data from a variety of sources, including non-INTEC wastes, and estimated the average Cs-137 and Sr-90 activity at 0.02 mCi/L (0.08 mCi/gal) in non-INTEC waste. This corresponds to a Cs-137 and Sr-90 activity of 740 d/s/mL. The historical waste samples did not contain data for H-3, Tc-99, or I-129 activity or nitrate concentration. Those constituents must be estimated. Assuming fission yield activity (no radionuclide partitioning) and relatively new waste (aluminum-clad fuel with 1.6 years of out-of-reactor cooling time) yields estimated activities of 0.08 μ Ci/L (0.3 μ Ci/gal) of H-3, 3 nCi/L (11 nCi/gal) of Tc-99, and 5 pCi/L (20 pCi/gal) of I-129. The waste from other sites was generally not high in any dissolved solids or highly acidic, and the pH was typically near neutral. Therefore, the nitrate concentration was also low, less than 0.01M.

5.4.1.3 Waste Volume Leaked to Soil. There is no compiled, detailed record of the leaks that occurred at the waste unloading station. Thus the total volume of waste that leaked is unknown. However, the waste unloading station was at an aboveground location where any leaks could be readily observed. The waste unloading station operation was typically observed by operators, the truck driver, and HP personnel. It is reasonable to assume that these personnel took reasonable actions to prevent gross leaks and minimize the size of any spill, and they cleaned up the contamination if such did occur. A reasonably conservative leak assumption would be 5 gal per spill and 20 spills over the life of the unloading station, for a total release of 100 gal of waste.

5.4.1.4 Source Term Summary. Site CPP-20 was contaminated by multiple small leaks over a multiyear period preceding 1978. The source of contamination was low-activity waste sent in tank trucks from non-INTEC INL sites (RTC, PBF, etc.) to the INTEC PEW evaporator for disposal. The contamination leaked to the soil from temporary hoses and connections used when unloading the waste from the tank trucks. Leaks from the system were observed and cleaned up at the time of the leak. In addition, the area was thoroughly excavated by INTEC upgrade projects in the early 1980s. Therefore, although leaks occurred occasionally while unloading waste tank trucks, not much of the original contamination likely still exists in the original unloading station area. Table 5-16 shows the contaminants released to Site CPP-20 assuming 100 gal of waste leaked. Compared to the amount of contamination released elsewhere in the tank farm area, such as CPP-31, the contamination released at CPP-20 is negligible. About 17,000 Ci of Cs-137 were released at Site CPP-31. This is over six orders of magnitude higher than the estimated activity released at CPP-20. Because the activity released at CPP-20 is such a small part of the total tank farm source term, further efforts to refine the estimated waste volume or activity released at CPP-20 are not recommended.

5.4.2 Cleanup

The entire waste unloading area was excavated in the early 1980s during installation of new waste transfer lines from CPP-601 to CPP-604 and Valve Box C-32, and waste tanks WL-132 and -133. Figures 5-7 through 5-10 show the extent of excavation at CPP-20. The entire area has been excavated and backfilled and the extent of contamination removed during these operations is unknown.

Table 5-16. Estimate of radionuclides and nitrate released at Site CPP-20.

Cs-137	Sr-90	H-3	Tc-99	I-129	NO ₃
8 mCi	8 mCi	30 µCi	1 µCi	2 nCi	0.23 kg



Figure 5-7. Excavation in 1982 north of Building CPP-604 looking west showing the soil that was removed.



Figure 5-8. Closeup view of 1982 excavation north of Building CPP-604 showing the soil that was removed.



Figure 5-9. Northeastern view of 1982 excavation north of Building CPP-604 showing extent of excavation through the CPP-20 and CPP-25 release sites.



Figure 5-10. Eastern view of 1982 excavation north of Building CPP-604 showing extent of excavation through the CPP-20 and CPP-25 release sites.

5.4.3 Previous Investigations

Site CPP-20 was originally included in OU 3-07, which underwent a Track 2 investigation in 1992 (WINCO 1993). On the basis of the information indicating contaminated soil had been removed from the site during the 1982 Fuel Processing Facility Upgrade project, the site was recommended for No Further Action, contingent on an evaluation of the contaminated backfill as part of the OU 3-13 BRA (DOE-ID 1997). As part of the OU 3-13 BRA, the site was evaluated using analytical results obtained from the High-Level Waste Tank Farm Upgrade (HLWTFU) project for excavated soils. In lieu of sampling the backfill soil used at the site, OU 3-13 used analytical data from these excavated soils

and represented them in the OU 3-13 BRA as CPP-20 sampling data. No actual sampling was performed at Site CPP-20.

5.4.4 Contamination Remaining in Alluvium

5.4.4.1 Nature of Contamination. No direct characterization sampling data exist for this site; however, process knowledge of the releases, described previously, conservatively bound the release inventory. The entire area was excavated and backfilled in 1982; therefore, the original release site no longer exists. The site is entirely contained within CPP-96 and Section 5.18 discusses expected contaminant concentrations at backfilled sites.

Because of the lack of confirmatory soil samples, it was conservatively assumed, for the purposes of the OU 3-13 BRA (DOE-ID 1997), that concentrations of inorganics and radionuclides in the upper 12.2 m (40 ft) of soil at Site CPP-20 were similar to concentrations in soil previously excavated from areas within the tank farm as part of a tank farm upgrade. In June 1995, 11 samples were collected from stockpiled contaminated soil to characterize concentrations of inorganics and radionuclides. Of the radionuclide COPCs, Sr-90 and Cs-137 had the highest average and maximum activities. The maximum Sr-90 and Cs-137 activities were 330 ± 3 and 114 ± 1 pCi/g, respectively. None of the other radionuclides detected had maximum activities greater than 2.2 pCi/g. Because of the lack of soil sampling in the area, soil concentrations from previously excavated tank farm soil were assumed representative of the soil beneath CPP-20 for risk assessment purposes.

5.4.4.2 Vertical Extent. The vertical extent of any remaining contamination at this site is entirely contained within CPP-96. Given the relatively small volumes of the surface releases and the depth of excavation in 1982, the entire original contaminated interval has been excavated and backfilled. Vertical extent is addressed in Section 5.18 for CPP-96.

5.4.4.3 Areal Extent. The areal extent of contamination at this site is entirely contained within CPP-96 and is discussed in Section 5.18.

5.4.4.4 Remaining Curies. The fraction of the total estimated release inventory of about 16 mCi remaining in the alluvium is unknown but, based upon the suspected extent of removal, a known composition of primarily Cs-137 and Sr-90, and known radioactive decay rates, the remaining activity is certainly less than one-half of that initially released. Contaminant inventory in the alluvium is discussed in Section 5.18 for CPP-96.

5.4.5 Uncertainties/Data Gaps

No significant data gaps remain for this site. The extent, distribution, and composition of contamination originally released and remaining are adequately known to complete the BRA and FS.

5.4.6 References

DOE-ID, 1997, *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL – Part A, RI/BRA Report (Final)*, DOE/ID-10534, U.S. Department of Energy Idaho Operations Office, November 1997.

Swenson, M. C., Exxon Nuclear Idaho Corporation, to W. B. Palmer, Exxon Nuclear Idaho Corporation, February 1, 1984, "PEW Evaporator Feed Stream Composition," MCS-01-84.

WINCO, 1993, *Track 2 Summary Report for Operable Unit 3-07 (Tank Farm Area I)*, Rev. 2, Westinghouse Idaho Nuclear Company, May 1993.

5.5 CPP-24

CPP-24 is the site where a bucket of liquid waste was dumped on the ground on February 15, 1954, near Tank WM-180 (see Figure 1-2).

5.5.1 Description of Release

Readily available information on this contamination incident is sketchy due to the elapsed time since the event (50 years). Most of the information comes from the Radioactivity Incident Report (ICPP 1954) written at the time of the event and process knowledge. The Radioactivity Incident Report was written by HP personnel and focused on radiological issues such as personnel and facility contamination and immediate actions to remove the contamination. Less emphasis was devoted to the operational aspects of the incident such as the source of the contamination. Previous studies and investigations imply the contamination came from first-cycle waste (by saying the waste contained mercuric nitrate, which is a component of 1950s first-cycle raffinate). However, the historical data show the source of contamination was not first-cycle raffinate. This section provides a plausible mechanism for the source of the contamination and level of radioactivity.

5.5.1.1 Background of System Configuration and Leak. WM-180 was one of the first two large (300,000-gal) waste tanks built in the tank farm. WM-180 was designed to store first-cycle raffinate, the waste that contained the bulk of the radioactivity from fuel reprocessing operations. Dissolution of spent nuclear fuel (SNF), uranium recovery, and generation of first-cycle raffinate began in the spring of 1953. First-cycle raffinate was stored in the 18,000-gal CPP-604 tanks (WM-100, -101, and -102) during the first year and a half of fuel reprocessing while a waste cooling system was designed and installed in WM-180. Thus, in February 1954, WM-180 was not in service. Instead, construction workers were installing cooling coils inside WM-180 to remove the heat produced by the decay of radioactive fission products in first-cycle raffinate.

The soil contamination at Site CPP-24 was not due to the failure of any installed piping or waste transfer system. Instead, it was a one-time event involving construction activities and the use of temporary containers (buckets). The Radioactivity Incident Report indicates contaminated water entered WM-180 on the south side from a location high above the floor of the tank. Construction workers collected the water in a bucket. They were apparently unaware of the source of the water or that it was contaminated and dumped it on the ground near WM-180, resulting in the contamination of Site CPP-24. The incident report indicates cleanup of the contaminated soil began immediately upon its discovery. Therefore, none of the contamination likely remains in the tank farm.

A review of the monthly operation reports and the system piping drawings shows the most likely source of the contaminated water in WM-180 was condensate from the CPP-604/tank farm vessel off-gas system. Although WM-180 was not in service, its vessel off-gas system was connected to the off-gas system of the CPP-604 tanks, where first-cycle raffinate was stored. Just prior to the contamination incident, the CPP Operations monthly reports indicate the first-cycle waste in the CPP-604 tanks was not being cooled and the waste temperature was 50–55°C. At that temperature, vapors were emitted from the waste into the vessel off-gas system. The off-gas system for the CPP-604 tanks vented to a condenser (WM-302) located in an underground vault between CPP-604 and WM-180. Downstream of the WM-302 condenser, the off-gas line from the CPP-604 tanks joined the off-gas line from WM-180. The off-gas line containing the combined flow from WM-180 and the CPP-604 tanks traveled underground for approximately 100 ft and then entered CPP-604. The CPP-604 tank off-gas condenser was probably

not in operation when the CPP-604 tanks were not being cooled. Therefore, the vapors from the CPP-604 tanks likely passed through the unused condenser, cooled, and condensed in the cool, underground off-gas line containing the combined CPP-604 tanks/WM-180 off-gas flow. The combined off-gas line sloped down to the WM-180 condenser (WM-300) where a condensate drain line directed liquid to a nozzle on the south side of WM-180, near the top of the tank wall.

The chance of condensation forming in the off-gas lines increased about the time of the CPP-24 contamination incident due to maintenance activities. At that time, Operations personnel overhauled the vessel off-gas system in CPP-604 because there were no fuel reprocessing operations underway that required the vessel off-gas system. As a result, there were times in February when the off-gas blowers were shut down and there was little airflow through the off-gas system to dilute any condensable vapors or flush them from the line. Such conditions likely promoted condensation in the WM-180 off-gas line.

The scenario of condensation formation in the off-gas system draining into WM-180 correlates with plant piping configuration, historical operations, and observations made by workers inside the tank who reported the contaminated water entered the tank from a location high on the south wall. It is likely the source of the CPP-24 contamination.

5.5.1.2 Waste Source Term. Data on the radionuclide activity in the contaminated liquid or soil are not readily available. The incident report indicates cleanup of the contamination began immediately, with no mention of any sampling or analysis. The source term can be estimated assuming the contaminated water was condensate from the vapor generated by the first-cycle waste in the CPP-604 tanks. Historical operation and sampling of the PEW evaporator system have shown the average ratio between the activity of radionuclides in the evaporator concentrate and the condensed vapor is about one million for nonvolatile constituents (Swenson 1984). This applies to nonvolatile radionuclides such as Cs-137, Sr-90, etc. For volatile constituents, such as tritium and I-129, the ratio is 1 (the activity in the concentrate is the same as the vapor/condensate). The activity of the contaminated condensate in WM-180 can be calculated by applying these ratios to the waste in the CPP-604 tanks in 1954.

In the early 1950s, INTEC reprocessed aluminum-clad fuel with relatively short (120-day) out-of-reactor cooling time. Lemon (1957) provides a source term for the major fission products of concentrated first-cycle raffinate from the early 1950s. The activity was dominated by short-lived species (half-lives of less than 1 year) such as Zr-95 (211 Ci/gal), Nb-95 (412 Ci/gal), Ce-144 (127 Ci/gal), and Sr-89 (143 Ci/gal). The Cs-137 and Sr-90 activities were “only” 5 and 6 Ci/gal respectively. The waste had a total activity of 1,470 Ci/gal (including short-lived daughter products of long-lived parents). A ratio of one million between the (nonvolatile) activity in the first-cycle raffinate and the off-gas condensate results in an estimated condensate activity of about 1.5 mCi/gal (0.40 mCi/L). If the activity were all beta emitters, the gross beta activity would have been about 8.9×10^5 beta disintegrations/min/mL. This is a reasonable value (order of magnitude) for the activity of condensed first-cycle raffinate vapors and could have produced the radiation field of 280 mR/hr measured in a bucket of contaminated water found inside WM-180.

Based on Lemon (1957), the bulk of the activity in early 1950s first-cycle waste was due to the relatively short-lived Zr-95 and Nb-95. Historical Operations monthly reports show the bulk of the activity in the PEW evaporator condensate at that time was also due to Zr-95 and Nb-95. In January 1954, the activity of the PEW evaporator condensate sent to service waste was 55.5% Zr-95, 32.5% Nb-95, and 10.2% rare earth metals (Ce-141 and Ce-144). In May 1954, the relative activities were similar, with 47% Nb-95, 24% Zr-95, 9% Ru-103 and Ru-106, 9% Ce-141 and Ce-144, and 1% Sr-89 and Sr-90. The fact that the relative activity of the first-cycle raffinate and the PEW evaporator condensate are similar to that of the first-cycle waste of the time gives confidence to the estimate of the activity in the off-gas condensate made by applying PEW evaporator concentration factors to the first-cycle raffinate.

Using the previously explained assumptions, the calculated activities (and a brief note of their derivation) of the long-lived radionuclides of interest in the contaminated condensate are as follows:

- Cs-137 = 5×10^{-6} Ci/gal (assume first-cycle raffinate:condensate activity ratio was 1×10^6)
- Sr-90 = 6×10^{-6} Ci/gal (assume first-cycle raffinate:condensate activity ratio was 1×10^6)
- I-129 = 0.67×10^{-6} Ci/gal (assume 67% of fission yield—see explanation below)
- H-3 = 13×10^{-3} Ci/gal (assume 67% of fission yield—see explanation below)
- Tc-99 = 6.7×10^{-6} Ci/gal (assume Tc-99 was 10 times the I-129 activity, based on Tc-99:I-129 ratios in “LF” aquifer well samples near the Central Facilities Area (CFA) (DOE-ID 2002) that represent historical PEW evaporator/service waste activity. This means Tc-99 was “semi-volatile,” more volatile than Cs but less than tritium or I-129).

In the original design of ICPP (now INTEC), the first-cycle raffinate from Al-clad fuel was concentrated by a factor of about 33% in waste evaporators in CPP-601. The estimated activities of I-129 and H-3 given above were reduced by 33% to account for their loss in the first-cycle waste evaporator. Other radionuclides such as Zr-95 and Nb-95 had much higher (10 to 100 times) activities than Cs-137 and Sr-90 in the contaminated condensate but are not listed above. They have decayed to virtually nothing in the time since the release due to their very short half-lives (a few weeks or months).

The nitrate content of the waste was likely about 0.1 M nitrate, assuming it was similar to PEW evaporator condensate.

5.5.1.3 Waste Volume Leaked to Soil. The exact volume of waste dumped to the ground is uncertain. Several documents (such as DOE-ID 2004) indicate the waste volume was approximately 1 gal. The original Radioactivity Incident Report indicates a bucket of liquid was dumped on the ground but does not specify the size of the bucket. The incident report indicates the contaminated soil occupied a small area, 3 ft by 6 ft, so the contaminated liquid was a small volume to contaminate a small area. A gallon is a reasonable assumption for the amount of contaminated liquid dumped on the ground. The location of the contamination site is also not precisely known. The incident report indicates it was the “ground on top of WM-180.” Construction personnel likely hauled the bucket of waste up out of the tank (via the manway in the center of the tank) and dumped it very near the access manway as there was no reason to haul the water any great distance. The contaminated soil map shows the location on the west side of the tank, a reasonable location.

5.5.1.4 Source Term Summary. CPP-24 was likely contaminated by 1 gal of condensate that formed in the waste storage vessel off-gas system and drained into WM-180. Construction workers installing cooling coils inside WM-180 collected the condensate in a bucket and dumped it on the ground, unaware that it was contaminated. The Radioactivity Incident Report indicates Operations personnel began decontamination of the tank and soil immediately after the contamination was discovered. This would have included removal of the contaminated soil. Therefore, virtually no contamination remains in the tank farm soil from this incident.

The CPP-24 contamination incident involved a small amount of waste with low activity. Table 5-17 summarizes the activity and nitrate released to the soil at the time of the incident, assuming a 1-gal release of the source term previously described. Table 5-17 provides the contaminants released without any consideration for the cleanup that occurred. The contaminated soil was removed by the cleanup effort performed at the time of the incident. In comparison with other tank farm soil

Table 5-17. Estimate of radionuclides and nitrate released at Site CPP-24.

Cs-137	Sr-90	H-3	Tc-99	I-129	NO ₃
5 µCi	6 µCi	13 mCi	6.7 µCi	0.67 µCi	0.023 kg

contamination sites, such as CPP-31 where approximately 17,000 Ci of Cs-137 leaked to the soil, CPP-24 is insignificant in additive terms to the overall impact to the environment or to any modeling source term. The Cs-137 activity released at CPP-31 was over nine orders of magnitude greater than the activity released at Site CPP-24. Therefore, further detailed estimates of source term for Site CPP-24 are not recommended.

5.5.2 Cleanup

The incident report indicates cleanup of the contaminated soil began immediately upon its discovery. Therefore, none of the contamination likely remains in the tank farm.

5.5.3 Previous Investigations

This site was recommended in a Track 2 investigation as a No Further Action site because the source was documented as having been removed (WINCO 1993).

5.5.4 Contamination Remaining in Alluvium

5.5.4.1 Nature of Contamination. The incident report indicates cleanup of the contaminated soil began immediately upon its discovery. Therefore, the original release site no longer exists, and none of the contamination likely remains in the tank farm. The original release site location is entirely contained within CPP-96. Section 5.18 discusses expected contaminant concentrations for CPP-96.

5.5.4.2 Vertical Extent. The original release site no longer exists and none of the contamination likely remains in the tank farm. The original site location is entirely contained within CPP-96.

5.5.4.3 Areal Extent. The original release site no longer exists and none of the contamination likely remains in the tank farm. The original site location is entirely contained within CPP-96.

5.5.4.4 Remaining Curies. The original release site no longer exists and none of the contamination likely remains in the tank farm. Contaminant inventory in the alluvium is discussed in Section 5.18 for CPP-96.

5.5.5 Uncertainties/Data Gaps

No significant data gaps remain for this site. The extent, distribution, and composition of contamination originally released and remaining are adequately known to complete the BRA and FS.

5.5.6 References

DOE-ID, 2002, *Annual INTEC Groundwater Monitoring Report for Group 5—Snake River Plain Aquifer (2001)*, DOE/ID-10930, Rev. 0, U.S. Department of Energy Idaho Operations Office, February 2002.

DOE-ID, 2004, *Operable Unit 3-14 Tank Farm Soil and Groundwater Remedial Investigation/ Feasibility Study Work Plan*, DOE/ID-10676, Rev. 1, U.S. Department of Energy Idaho Operations Office, June 2004.

ICPP, 1954, "Radioactivity Incident Report," for ICPP contamination incident of February 15, 1954, signed February 16, 1954.

Lemon, R. B., Phillips Petroleum Company, to Conrad P. Straub, Taft Sanitary Engineering Center, January 30, 1957, "Radioactive Waste Data," Lem-4-57A.

Swenson, M. C., Exxon Nuclear Idaho Corporation, to W. B. Palmer, Exxon Nuclear Idaho Corporation, February 1, 1984, "PEW Evaporator Feed Stream Composition," MCS-01-84.

WINCO, 1993, *Track 2 Summary Report for Operable Unit 3-07 (Tank Farm Area I)*, Rev. 2, Westinghouse Idaho Nuclear Company, May 1993.

5.6 CPP-25

Site CPP-25 (Figure 1-2) is located on top of the berm immediately north of Building CPP-604 and overlaps Site CPP-20 (Figure 5-11). The CPP-25 site was contaminated on August 28, 1960, when a valve on a temporary, aboveground, transfer line leaked.

5.6.1 Description of Release

In August 1960, waste was transferred from Tank WM-181 to the PEW evaporator feed collection tank WL-102 for subsequent concentration in the PEW evaporator. This was done to increase the limited tank farm volume available for waste storage. The waste in WM-181 had been diluted by multiple steam jet transfers and the addition of over 20,000 gal of tank vault sump water (from the failure of a nearby firewater line). The waste transfer used a temporary pump in WM-181 to send waste via a temporary transfer line to a set of aboveground pipe stubs located on the top of the berm north of CPP-604. One of the pipe stubs led to WL-102. This transfer used the same pipe stub that was used for many years to receive non-INTEC waste via tank truck and was the source of contamination at Site CPP-20.

5.6.1.1 Background of System Configuration and Leak. According to the Operations monthly report (DOE-ID 2004)), the contamination occurred because a valve on the transfer line leaked. The valve was likely on the WL-102 inlet pipe stub. When the leaked occurred, the waste transfer was terminated and remediation efforts began. This included replacing the leaking valve with a bellows seal valve (which was inherently less prone to external leakage) and removing contaminated soil. Waste transfers resumed in 3 days, after the valve was repaired and cleanup work was completed. The Radioactivity Incident Report (1960) indicates the contamination occurred when a line “ruptured.” It also reports 9 yd³ of soil were removed as part of the cleanup effort.

Both reports indicate the contaminated soil was immediately removed from the area, so there is likely little if any of the original contamination remaining. The area was thoroughly excavated in the early 1980s during the construction work to install new waste transfer lines between CPP-601 and CPP-604 and to install WL-132 and -133 tanks.

5.6.1.2 Waste Source Term. There are no known analytical data for the WM-181 waste that was sent to the PEW evaporator for concentration in 1960. Approximately 300,000 gal of WM-181 waste was converted into 150,000 gal of concentrate that was sent to WM-184 for storage. The waste in WM-184 was sampled in 1964 (Komanik 1964), shortly after receiving the WM-181 concentrate. At the time it was sampled, WM-184 was full (286,000 gal), so the WM-181 concentrate comprised slightly over half of the WM-184 waste. The remaining portion of the WM-184 waste came from the same sources as the WM-181 waste, PEW evaporator concentrate and second-/third-cycle uranium reprocessing raffinate. Since the WM-181 waste was concentrated by a factor of two, its composition can be estimated as one-half of the concentrated WM-184 waste for which sample data exist.

Based on a factor of one-half of the activity of the 1964 WM-184 sample, the estimated activity of Cs-137 in WM-181 was 8 mCi/L (30 mCi/gal) and the Sr-90 was 6 mCi/L (23 mCi/gal). The 1964 sample did not include any data for Tc-99, H-3, or I-129. Assuming fission yield (for 7-year-old waste), the Tc-99 in the WM-181 waste was about 1.3 µCi/L (4.9 µCi/gal). The activity of I-129 and H-3 can also be estimated by fission yield and then reduced to account for their reduction in the PEW evaporator. Using a reduction factor of 80% for such isotopes yields an estimated activity of 5.2 µCi/L (20 µCi/gal) for H-3 and 2.1 nCi/L (8.1 nCi/gal) for I-129.

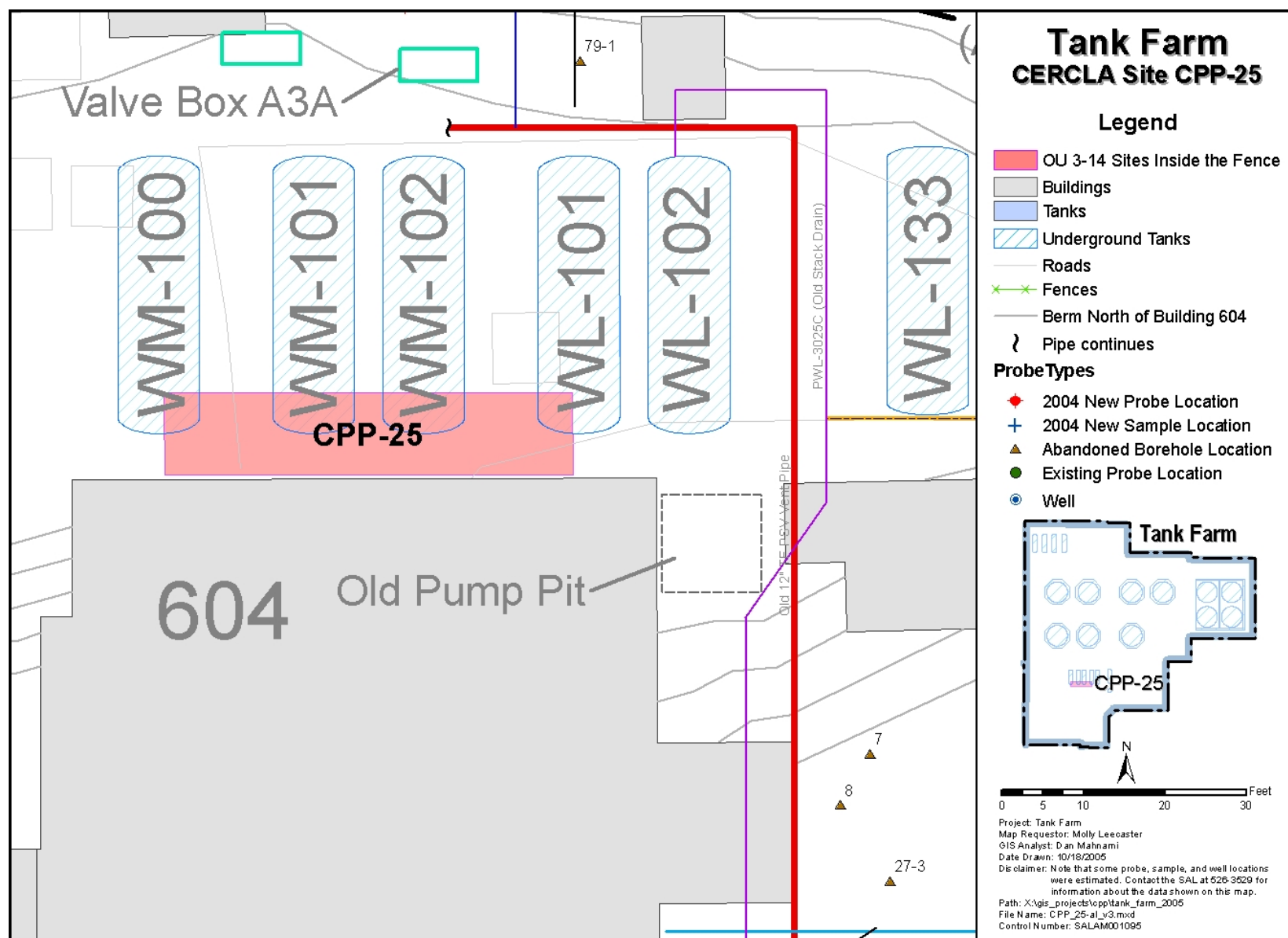


Figure 5-11. Detail of Site CPP-25 infrastructure.

The nitrate concentration of the WM-181 waste was about 3 M, assuming it was a factor of two less than the WM-184 nitrate concentration.

5.6.1.3 Waste Volume Leaked to Soil. Neither the Radioactivity Incident Report nor the Operations monthly report gives the volume of waste that leaked. The line was a temporary, aboveground line, so any leaks were readily visible. The waste transfer could have been readily terminated if a leak were observed. The Operations monthly report and the incident report include different phrases and details from which a different size of leak can be inferred. The Operation monthly report implies there was a valve-packing leak because it reports a leaking valve was replaced with a bellows seal valve. A valve-packing leak would likely have been a relatively small volume, perhaps a few gallons. The line was under pressure because a temporary pump was used to make the waste transfer. Therefore, although the leak may have been only a few gallons, it may have been in the form of a fine spray that contaminated a relatively large surface area. This would explain why a fairly substantial amount of dirt (9 yd³) was removed.

The Radioactivity Incident Report implies a potentially larger leak resulting from a “ruptured line”. In order to get a better estimate for the size of leak, several former (retired) INTEC workers (supervisors, operators, maintenance crafts, and health physicists)^a who were at INTEC at the time of the leak were contacted and asked about the occurrence. None of them had any recollection of the incident. Several workers opined that after nearly half a century a minor valve-packing leak would be forgotten, but a major leak from a ruptured line would certainly be remembered. It is thus assumed the leak was relatively small in volume, but covered a relatively large area, thus accounting for the large amount (9 yd³) of contaminated soil. A leak of 10 gal is a reasonable estimate for valve-packing leak.

5.6.1.4 Source Term Summary. Site CPP-25 was contaminated in August 1960 when a valve on a temporary line leaked. The line was used to transfer waste from WM-181 to the PEW evaporator feed collection tank WL-102. The leak was likely from a valve associated with the Tank WL-102 inlet piping. The contaminated soil was immediately removed following the leak, so little, if any, of the original contamination remains. Although the volume of waste that leaked is not certain, the amount of activity released is not a significant source to the groundwater model in comparison with other tank farm releases. Table 5-18 shows the contaminants released at Site CPP-25 assuming a 10-gal leak. Table 5-18 does not account for any contaminated soil removal. The Cs-137 released at CPP-25 was nearly five orders of magnitude less than the activity released at Site CPP-31. Because of the small amount of activity, further development of a detailed source term for CPP-25 is not recommended.

5.6.2 Cleanup

As described for CPP-20, the area was thoroughly excavated in the early 1980s during the construction work to install new waste transfer lines between CPP-601 and CPP-604 and to install WL-132 and -133 tanks. Little, if any, of the original contamination remains in the area.

Table 5-18. Estimate of radionuclides and nitrate released at Site CPP-25.

Cs-137	Sr-90	H-3	Tc-99	I-129	NO ₃
0.30 Ci	0.23 Ci	0.20 mCi	49 µCi	81 nCi	7.0 kg

a. L. P. Mickelsen, C. Murray, M. Young, L. Robertson, R. Jensen, E. Belnap.

5.6.3 Previous Investigations

Site CPP-25 underwent a Track 2 investigation in 1992 (WINCO 1993). On the basis of the information indicating contaminated soil had been removed from the site during the Fuel Processing Facility Upgrade project, the site was recommended for No Further Action, contingent on an evaluation of the contaminated backfill as part of the OU 3-13 RI/FS. Expected contamination resulting from use of contaminated backfill is described in Section 5.18.

Because of the lack of confirmatory soil samples it was conservatively assumed, for the purposes of the OU 3-13 BRA (DOE-ID 1997), that concentrations of inorganics and radionuclides in the upper 12.2 m (40 ft) of soil at Site CPP-25 were similar to concentrations in soil previously excavated from areas within the tank farm as part of a tank farm upgrade. In June 1995, 11 samples were collected from stockpiled contaminated soil to characterize concentrations of inorganics and radionuclides. Of the radionuclide COPCs, Sr-90 and Cs-137 had the highest average and maximum activities. The maximum Sr-90 and Cs-137 activities were 330 ± 3 and 114 ± 1 pCi/g, respectively. None of the other radionuclides detected had maximum activities greater than 2.2 pCi/g. Because of the lack of soil sampling in the area, soil concentrations from previously excavated tank farm soil were assumed representative of the soil beneath CPP-25 for risk assessment purposes.

5.6.4 Contamination Remaining in Alluvium

5.6.4.1 Nature of Contamination. No sampling data exist for this site; however, process knowledge of the releases, described previously, conservatively bound the release inventory. The entire area was excavated and backfilled in 1982; therefore, the original release site no longer exists. Section 5.18 discusses expected contaminant concentrations at consolidated backfill and tank farm soil sites.

5.6.4.2 Vertical Extent. Given the relatively small volumes of the surface releases and the depth of excavation in 1982, the entire contaminated interval has been excavated and backfilled. Vertical extent is addressed in Section 5.18 for soils inside the tank farm boundary.

5.6.4.3 Areal Extent. The areal extent of contamination at this site is entirely contained within the tank farm boundary and is discussed in Section 5.18.

5.6.4.4 Remaining Curies. The contamination was reportedly removed at the time the release was discovered; therefore, essentially none is estimated to remain. Contaminant inventory in backfill and alluvium for inside the tank farm boundary is discussed in Section 5.18.

5.6.5 Uncertainties/Data Gaps

No significant data gaps remain for this site. The extent, distribution, and composition of contamination originally released and remaining are adequately known to complete the BRA and FS.

5.6.6 References

DOE-ID, 1997, *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL-Part A, RI/BRA Report (Final)*, DOE/ID-10534, U.S. Department of Energy Idaho Operations Office, November 1997.

DOE-ID, 2004, *Operable Unit 3-14 Tank Farm Soil and Groundwater Remedial Investigation/Feasibility Study Work Plan*, DOE/ID-10676, Rev. 1, U.S. Department of Energy Idaho Operations Office, June 2004.

Komanik, N., 1964, Internal notegram on the composition of wastes in tanks WM-181, -184, and -186, September 24, 1964.

Radioactivity Incident Report dated August 28, 1960.

WINCO, 1993, *Track 2 Summary Report for Operable Unit 3-07 (Tank Farm Area I)*, Rev. 2, Westinghouse Idaho Nuclear Company, Inc., May 1993.

5.7 CPP-26

Site CPP-26 (see Figure 1-2) was contaminated on May 10, 1964, while decontaminating tank farm waste transfer lines in preparation for construction activities.

5.7.1 Description of Release

An incident report (Cooper 1964) describes the events associated with the waste release. In spring 1964, construction work was in progress on the last two 300,000-gal waste storage tanks (WM-189 and -190) built at INTEC. In May 1964, construction workers connected four existing tank farm waste transfer lines with corresponding lines associated with the two new tanks. The four existing lines ran in an east/west direction between existing tanks WM-187 and -188. The four existing lines had valves and piping junctions necessary to fill and empty tanks WM-187 and -188 in Valve Box B-9, located on the west end of the WM-187 and -188 tank vaults (Figure 5-12). The four lines extended approximately 55 ft east of Valve Box B-9 to a junction box (JB-7) where they terminated. The purpose of the line extensions was to provide a convenient tie-point for future tank farm construction (such as the WM-189 and -190 construction project). The line extensions eliminated the need for construction personnel to enter high radiation and contamination areas associated with the lines in Valve Box B-9. The line extensions sloped to the east from Valve Box B-9, making the construction tie-point the low spot in each transfer line. The transfer lines were equipped with isolation valves in Box B-9 to keep waste from entering the extensions and to maintain low radiation fields at the tie point. A decontamination line with four branches, one to the end of each of the four line extensions, was installed near JB-7 for the purpose of decontaminating the line extensions should they become contaminated.

5.7.1.1 Background of System Configuration and Leak. On May 8, 1964, the first of four waste transfer line connections was made. Prior to making the connection, a small hole was drilled in the existing transfer line. Cooper (1964) indicates approximately 2 gal of liquid drained from the line into buckets. The radiation reading of a 1-gal bucket of waste was about 5 R/hr at 1 ft, indicating very high levels of activity in the solution. The contaminated solution was waste that had leaked through an isolation valve in Box B-9 and drained to the construction tie-point at the end of the line extension. Based on the high activity and contamination found when making the first line connection, an attempt was made to lower the radiation fields in the remaining transfer lines using the installed decontamination system.

A procedure was developed to clean the line extensions by adding steam via the decontamination piping to the transfer lines and flushing any contaminated solution back into a waste storage tank. A temporary steam hose was connected to the decontamination-piping stub (which terminated above the ground just east of Building CPP-635). The tank farm valves were positioned to allow steam flow through one of the existing transfer lines and into a waste tank. However, the flushing did not go as planned when the steam valve was opened. Instead of establishing steam flow through an open transfer line, the pressure in the steam line increased to plant steam pressure, indicating there was no open path into a tank. Then the fitting connecting the temporary steam hose with the decontamination piping failed and began leaking contaminated steam and mist. The contaminated mist spread over a relatively large area north and east of CPP-635 due to shifting, high-speed winds (28-40 mph).

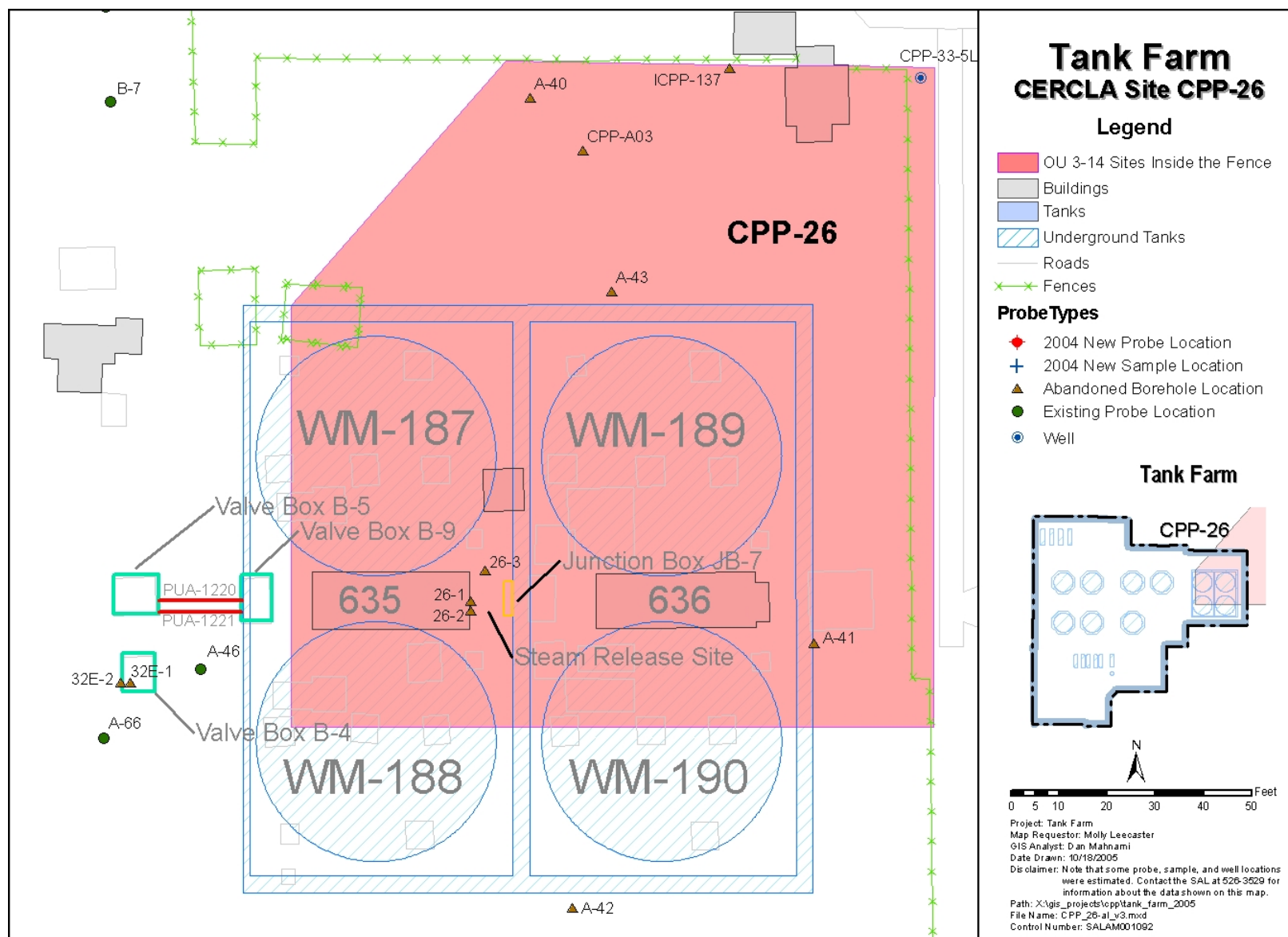


Figure 5-12. Details of CPP-26.

Later investigation found the problem with the flushing operation was the result of mislabeled decontamination valves. Operations personnel correctly positioned the tank farm valves to establish an open path for the steam through one of the transfer line extensions and into a tank. However, when they opened the (mislabeled) decontamination valve, the steam entered one of the isolated (closed valves) lines instead of the open transfer line. As a result, the steam pressurized the isolated line extension that held a small amount of waste. When the steam fitting failed, the steam in the isolated line entrained some of the contaminated solution as it discharged from the failed fitting, contaminating the CPP-26 site.

5.7.1.2 Waste Source Term. The waste source term for CPP-26 is fairly certain. The waste in the line extensions had leaked through isolation valves in Box B-9. At the time, the only waste in those lines had been sent into or out of WM-187 or -188. No other waste transfers used those sections of tank farm piping. Waste began entering WM-187 and -188 in late 1959. Between 1959 and 1964 waste was transferred into and out of both WM-187 and -188, with much of the waste entering in 1963. The waste was first-cycle raffinate from the dissolution of aluminum-clad fuel. The waste was sampled and analyzed, as recently as March 1964, just 3 months prior to the leak, when calcination of the waste in WM-187 began (Cooper 1964 and Lakey 1962). The waste sample analyses included the major nuclides such as Cs-137 and Sr-90 but did not include minor species such as I-129. Due to the age of the waste (an average of about 2.5 years) there was little activity of the short-lived radionuclides such as Zr-95 and Nb-95. The radionuclide activities in the waste and their basis of estimate are as follows:

Cs-137 = 1.0 Ci/L (3.8 Ci/gal)	(Sample data)
Sr-90 = 1.0 Ci/L (3.8 Ci/gal)	(Sample data)
Tc-99 = 1.5E-04 Ci/L (5.7E-04 Ci/gal)	(Assume fission yield ratio to Cs-137)
I-129 = 1.6E-07 Ci/L (6.1E-07 Ci/gal)	(Assume 67% of fission yield ratio to Cs-137, in the following paragraph)
H-3 = 2.7E-03 Ci/L (1.0E-02 Ci/gal)	(Assume 67% of fission yield ratio to Cs-137, in the following paragraph).

In the original design of ICPP, the first-cycle raffinate from reprocessing Al-clad fuel was concentrated by a factor of 33% in waste evaporators in CPP-601. The estimated activities of I-129 and H-3 were reduced by 33% to account for their loss in the first-cycle waste evaporator.

The nitrate concentration of the waste was 5.6 M.

5.7.1.3 Waste Volume Leaked to Soil. The volume of waste that leaked is less certain than the source term activity, though the leakage has an upper limit set by the piping configuration. The estimated “upper limit” of the activity released is based on a release of 15 gal of waste (DOE-ID 2004). The 15-gal estimate was based upon filling the entire eastern extension of the waste transfer line from Valve Box B-9 to JB-7 with first-cycle raffinate. This is the maximum amount of waste that could have been in the line and likely overestimated the volume of waste and activity released to the environment. A waste volume similar to that drained from the line with a similar configuration is a more reasonable estimate of the waste volume released.

The WM-189 and -190 construction project connected four existing waste transfer lines with the project piping. Of the four existing waste transfer lines, two were designed for low-activity waste (called SBW today) and had never been used at the time of the activity release. The other two lines were designed and had been used for first-cycle (high-activity) waste transfers; consequently, their line extensions were contaminated. Due to the configuration of the piping (source and destination of the waste transfers), one of the two first-cycle waste lines (PUA-1221) was used for the vast majority of

the waste transfers (several hundred) in and out of WM-187 and -188. The other first-cycle waste line, PUA-1220, had seen minimal use (less than 10 transfers). The piping extensions were contaminated when waste leaked through isolation valves in Valve Box B-9. Over time, and with repeated exposure to waste solutions, some valve components failed and the valves began to leak. The extension of Line PUA-1221 was more likely contaminated by leaking valves than the extension of Line PUA-1220, due to its higher frequency of use and associated higher probability of valve leaks. Line PUA-1221 was the first line construction workers connected to the new WM-189 and -190 piping. Construction workers drained about 2 gal of waste from PUA-1221 via a hole drilled into the line before making the piping connection. Due to its less frequent use, the extension of Line PUA-1220 likely held less waste than PUA-1221. Even if the line held 2 gal of waste (the same as the first line), the steam entrained only a portion of the waste when the leak occurred. Some of the waste remained in the transfer line low point and was not released. Therefore, even a volume of 2 gal is likely a conservatively high estimate of the amount of waste released to the environment. This is less than the 15 gal conservatively assumed in DOE-ID (2004).

5.7.1.4 Source Term Summary. The CPP-26 contamination was a one-time occurrence involving the failure of temporary piping components. High-pressure steam was applied to an isolated section of contaminated piping due to a valve labeling error. A fitting in the temporary steam line failed, releasing the steam to the environment. The escaping steam entrained some of the contaminated liquid in the line and carried it into the environment. The contaminated area was large due to the dispersion of the contaminated mist by high winds that existed at the time of the leak. Much of the surface contaminated by the release was disturbed by subsequent activities, including the construction of Building CPP-699, Building CPP-654, and some of the Calcined Solids Storage Facilities (CSSFs).

The CPP-26 contamination incident involved a small amount of waste with high activity. Table 5-19 summarizes the activity and nitrate released to the soil at the time of the incident, assuming a 2-gal release of the source term previously described. Table 5-19 provides the contaminants released without any consideration for the cleanup that occurred. The CPP-26 contamination incident was significant in terms of the total surface area contaminated, due to the dispersion of the contamination by the wind. However, in comparison with other tank farm soil contamination sites, such as CPP-31 where approximately 17,000 Ci of Cs-137 leaked to the soil, CPP-26 is not significant in additive terms to a tank farm modeling source term. The Cs-137 released at Site CPP-31 was over three orders of magnitude greater than the activity released at Site CPP-26. Due to the relatively low amount of activity released, further detailed source term development is not recommended for Site CPP-26.

5.7.2 Cleanup

The steam release occurred during the construction of the last two storage tanks, WM-189 and WM-190. The existence of surficial contamination from the release posed an exposure risk to construction workers working inside the tank farm security fence. This risk was mitigated by wetting down the area where the release occurred. Lawn sprinklers were reported to have been used to wet the area for 1 to 2 days, after which construction activities resumed.

Table 5-19. Estimate of radionuclides and nitrate released at Site CPP-26.

Cs-137	Sr-90	H-3	Tc-99	I-129	NO ₃
7.6 Ci	7.6 Ci	20 mCi	1.1 mCi	1.2 µCi	2.6 kg

Reportedly, liquid present near the header was cleaned up, solidified, and sent to the Radioactive Waste Management Complex (RWMC) for disposal at the time of the release. The entire CPP-26 site has been disturbed extensively since the release. A portion of the release site nearest to the decontamination header was excavated during the construction of Buildings CPP-699 and CPP-654 and Bin Sets 4, 5, and 6 at the CSSF. Any remaining contamination from the release that is within the current tank farm boundaries has been covered with 2 ft of soil, a 20-mil-thick membrane liner, and an additional 6 in. of soil to prevent the liner from blowing away. Therefore, the contamination from the steam release would be expected to be approximately 2.5 ft bgs in the tank farm area.

5.7.3 Previous Investigations

A sample of mud was collected near the decontamination header after the release. The mud was found to contain 520 pCi/g of Cs-137, 3.3 pCi/g of Cs-134, 22,400 pCi/g of Ce-144, 3,600 pCi/g of Ru-106, 810 pCi/g of Ru-103, and 0.03 pCi/g of Pu-242. A surface radiation survey after the 1964 incident detected between 2 and 10 mR/hr in the soil, with one area as high as 200 mR/hr of gross radiation.

In 1991, a surface radiation survey of the area was performed. No elevated beta/gamma radiation was detected on the surface outside the tank farm on areas undisturbed since the steam release incident. Site CPP-26 was characterized as part of the OU 3-07 Track 2 investigation in 1992 (WINCO 1993). A stainless-steel hand auger was used to drill three boreholes in the tank farm soil near the location of the steam release to determine the nature and extent of residual contamination. These three boreholes were located to the east and northeast of Building CPP-635. Two boreholes were drilled to approximately 6 ft below the tank farm liner; the third borehole was abandoned at 4 ft below the liner because of the presence of concrete. Nine soil samples, including three duplicate samples, were collected from the three boreholes. The selection of the appropriate depths to collect the soil samples from the boreholes was based on the highest measured radiation reading on soil collected as the borehole was drilled. The collected samples were analyzed for VOCs, selected metals, fluoride, nitrate, nitrite, pH, and radionuclides. The analytical results of the soil samples are presented in Table 5-20.

The radionuclides detected in the soil during the Track 2 investigation consist primarily of Sr-90, Cs-137, Eu-154, and lower levels of Pu-238, Pu-239, and Am-241. The highest concentrations (Sr-90 up to 15,800 pCi/g and Cs-137 ranging from 108 ± 9.08 to $6,460 \pm 465$ pCi/g) were measured in samples collected between 4 and 5 ft bgs (WINCO 1993). The radionuclide distribution observed in the soils may be attributed to the use of sprinklers wetting down the area after the steam release or may be the result of excavating and backfilling with contaminated soil during the previously described construction activities.

5.7.4 Contamination Remaining in Alluvium

5.7.4.1 Nature of Contamination. Contamination observed in previous investigations is consistent with the conceptual model of the release and the source term described previously, i.e., an airborne release of steam containing a small amount of first-cycle raffinate.

5.7.4.2 Vertical Extent. The vertical extent of any remaining contamination at this site is entirely contained within the tank farm boundary. The area of the original release has been disturbed during construction and covered with the tank farm liner and soil cover. Vertical extent of any remaining contamination is addressed in Section 5.18 for soils inside the tank farm boundary.

Table 5-20. Analytical results for the soil samples collected at CPP-26.

Borehole	CPP-26-1		CPP-26-1		CPP-26-1		CPP-26-2		CPP-26-2		CPP-26-2		CPP-26-3		CPP-26-3		CPP-26-3	
Depth (ft)	3.8 – 4.7		5.5 – 6.0		5.5 –6.0 (Duplicate)		4.0 – 4.7		4.0 – 4.7 (Duplicate)		5.7 – 6.1		1.0 –1.8		1.8 –2.7		1.8 –2.7 (Duplicate)	
Sample Number	30700101		30700201		30700301		30700401		30700601		30700501		30700701		30700801		30700901	
	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q
Toluene	0.002	J	0.001	J	0.001	J	0.005	U	0.005	U	0.005	U	0.001	J	0.005	U	0.005	U
Chromium	12.1		10.3	U	a		10.7		10.4		11.8		10.6		14.8		15.5	
Manganese	199	J	147	J	a		218	J	138	J	143	J	127	J	238	J	194	J
Mercury	0.2	U	0.12	U	a		0.16	U	0.15	U	0.12	U	0.27	U	0.25	U	0.30	U
Nickel	17.5	J	14.0	J	a		13.4	J	12.5	J	11.6	J	11.2	J	19.4	J	18.3	J
Nitrate	2.9	J	2.70	J	2.30	J	1.6	J	1.60	J	1.90	J	0.79	J	2.2	J	92.0	J
Nitrite	0.21	UJ	0.21	UJ	0.21	UJ	0.21	UJ	0.21	UJ	0.20	UJ	0.21	UJ	0.21	UJ	0.21	UJ
Fluoride	2.09	J	1.74	J	a		1.59	J	1.64	J	1.58	J	1.69	J	1.92	J	1.73	J
pH	9.02 (no units)		9.11 (no units)		9.38 (no units)		9.28 (no units)		9.37 (no units)		9.32 (no units)		9.21 (no units)		9.17 (no units)		8.99 (no units)	
Radionuclides	Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)	
Gross Alpha	188 ± 22.7	J	46.4 ± 5.76	J	46.1 ± 5.77	J	233 ± 28.1	J	302 ± 36.4	J	127 ± 15.4	J	16.0 ± 2.22	J	41.5 ± 5.27	J	23.3 ± 3.0	J
Gross Beta	20,200 ± 1,620		3,530 ± 283		2,790 ± 224		25,600 ± 2,050		35,500 ± 2,840		15,200 ± 1,220		151 ± 12.4		579 ± 46.6		451 ± 36.4	
Cs-137	6,460 ± 465		904 ± 61.2		665 ± 45.1		5,330 ± 390		6,730 ± 485		1,380 ± 101		108 ± 9.08		259 ± 18.7		176 ± 11.9	
Eu-154	10.7 ± 0.92		1.01 ± 0.132		1.07 ± 0.14		6.81 ± 0.49		7.30 ± 0.732		2.27 ± 0.023		0.163 ± 0.044		0.65 ± 0.038		0.61 ± 0.071	
K-40	19.3 ± 1.98		18.7 ± 1.12		17.7 ± 1.05		16.8 ± 1.23		18.6 ± 1.94		18.7 ± 1.29		21.7 ± 1.06		20.9 ± 1.02		16.9 ± 0.86	
Sr-90	8,390 ± 121	J	1,740 ± 68.4	J	1,350 ± 33.2	J	15,300 ± 146	J	15,800 ± 106	J	8,230 ± 154	J	33.8 ± 2.31	J	210 ± 7.7	J	146 ± 5.82	J
U-234	1.16 ± 0.135		0.98 ± 0.11		1.13 ± 0.11		1.24 ± .143		1.26 ± 0.142		1.03 ± 0.13		NA		2.21 ± 0.14		1.42 ± 0.095	
U-235	0.0454 ± 0.014		0.049 ± 0.015		0.082 ± 0.03	U	0.055 ± 0.03		0.023 ± 0.019	U	0.0074 ± 0.011	U	NA		0.10 ± 0.026		0.050 ± 0.016	
U-238	1.11 ± 0.13		1.03 ± 0.11		1.25 ± 0.12		0.79 ± 0.11		1.01 ± 0.13		0.92 ± 0.12		NA		1.03 ± 0.086	J	0.93 ± 0.072	J
Pu-238	3.58 ± 0.279	J	0.21 ± 0.053	J	0.19 ± 0.051	J	1.67 ± 0.173	J	2.71 ± 0.25	J	0.35 ± 0.071	J	NA		3.09 ± 0.19		0.84 ± 0.077	
Pu-239	0.841 ± 0.121		0.013 ± 0.0013	U	0.041 ± 0.023	U	0.60 ± 0.099		0.67 ± 0.12		0.084 ± 0.034		NA		0.16 ± 0.033		0.096 ± 0.024	
Pu-242	NA		NA		NA		ND		ND		NA		NA		NA		NA	
Am-241	0.57 ± 0.079		0.23 ± 0.051		0.173 ± 6.78E-02	J	0.53 ± 0.079		0.38 ± 0.066		0.14 ± 0.04		NA		1.34 ± 0.087		0.64 ± 0.074	
a = contaminated during sample shipment. U = Indicates the compound was analyzed for but not detected. The reported value is the sample quantitation limit. UJ = Indicates the compound was analyzed for but not detected. The reported value is an estimate of the sample quantitation limit. J = indicates the value reported is an estimate. B = indicates the value reported is less than the contract-required quantitation limit but greater than the instrument detection limit. NA = not analyzed. ND = no data. Q = qualifier.																		

5.7.4.3 Areal Extent. The areal extent of contamination at this site is entirely contained within the tank farm boundary and is discussed in Section 5.18. Gamma/beta surveys outside the tank farm downwind of the release show no elevated readings. The entire areal extent of the original release has been disturbed during construction and covered with the tank farm liner and soil cover.

5.7.4.4 Remaining Curies. The fraction of the total estimated release inventory of about 15 Ci remaining in the alluvium is unknown but, based upon the suspected extent of removal, a known composition of primarily Cs-137 and Sr-90, and known radioactive decay rates, the remaining activity is certainly less than one-half of that initially released.

5.7.5 Uncertainties/Data Gaps

No significant data gaps remain for this site. The extent, distribution, and composition of contamination originally released and remaining are adequately known to complete the BRA and FS.

5.7.6 References

Cooper, E. D., Phillips Petroleum Company, to J. W. Garner, Phillips Petroleum Company, May 6, 1964, "ICPP Waste Analyses," Coop-3-64A.

DOE-ID, 2004, *Operable Unit 3-14 Tank Farm Soil and Groundwater Remedial Investigation/Feasibility Study Work Plan*, DOE/ID-10676, Rev. 1, U.S. Department of Energy Idaho Operations Office, June 2004.

Lahey, L. T., Phillips Petroleum Company, to J. A. Buckham, Phillips Petroleum Company, December 18, 1962, "ICPP Waste Tank Analyses," Lak-42-62A.

WINCO, 1993, *Track 2 Summary Report for Operable Unit 3-07 (Tank Farm Area I)*, Rev. 2, Westinghouse Idaho Nuclear Company, Inc., May 1993.

5.8 CPP-27/33

CPP-27/33 is located east of Building CPP-604 (Figure 1-2) and is associated with transfers of WCF solution to the PEW evaporator. It accounts for approximately 4% of the Cs-137 and Sr-90 activity released in OU 3-14. The source release estimate described below is included as a source term for the groundwater model. The contaminant concentrations in the 0 to 4-ft interval bls as well as additional discussion of the release and subsequent cleanup are provided in Section 5.18. The origin of the release, subsequent cleanups, and results of investigations are discussed below.

5.8.1 Description of Release

Sites CPP-27 and CPP-33 were contaminated when transfers of nitric acid solution from the WCF to the PEW evaporator backed up (via a drain line) into the carbon-steel tank farm pressure relief line. The acidic solution dissolved the carbon-steel line and then leaked into the surrounding soil. The bulk of the contamination occurred during the mid-1960s, during the first two WCF operating campaigns, when valve failures at WCF resulted in large quantities (over 200,000 gal) of WCF scrub solution being sent to the PEW evaporator. Table 5-21 shows the contaminants released to Sites CPP-27 and CPP-33 assuming 540 gal of WCF scrub solution and an additional 500 gal of low-activity, 4.5 molar nitric acid waste (such as decontamination solution) leaked. Although the amount of activity released is significant, the activity of most of the radionuclides released is an order of magnitude less than the activity released at Site CPP-31. In addition most of the nonmobile activity was removed during the construction projects that discovered the contamination.

Table 5-21. Estimate of major radionuclides and nitrate released at Sites CPP-27 and CPP-33.

Cs-137	Sr-90	H-3	Tc-99	I-129	NO ₃
750 Ci	720 Ci	1.2 Ci	120 mCi	0.33 mCi	1,100 kg

5.8.1.1 Background of System Configuration and Leak. Site CPP-27 is located directly east of Building CPP-604. (Figure 5-13). Site CPP-33 is located at the northeast corner of CPP-604. The two sites were contaminated by the same source but were encountered in two separate construction and excavation activities. The first was in 1974 (CPP-27) during the construction of a new PEW evaporator cell on the east side of CPP-604. The second was in 1983 (CPP-33) during the construction of a new PEW evaporator feed collection system (WL-132 and WL-133). Thus, a single contamination source was assigned two different contamination site identification numbers. For simplicity, the site is referred to as CPP-27. The bulk of the contamination likely occurred in the mid-1960s when acidic waste from the WCF backed up into a carbon-steel, tank farm off-gas line (via a condensate drain line), corroded the off-gas line, and leaked into the surrounding soil. This resulted in one of the largest radioactivity releases in the INTEC tank farm, approximately equal to that of CPP-28 and second only to that of CPP-31. The events surrounding the release are documented in a Significant Operating Occurrence Report (Staiger 1974) and a “class B” investigation report (Anderson 1974).

The original INTEC tank farm design included two off-gas systems for the 300,000-gal waste storage tanks. The system through which the tanks normally vented was constructed entirely of stainless steel and went from the storage tanks to the off-gas treatment system located in CPP-604. The second system was a backup system to provide overpressure or underpressure relief in the event of an emergency. It consisted of a stainless-steel line that led to a combination pressure/vacuum-relief valve (also made of stainless steel) located near the tank vault. Downstream of the relief valve, the system consisted of a 12-in. carbon-steel line that led to the main INTEC exhaust stack (CPP-708). The carbon-steel pressure-relief line sloped to a low spot located east of CPP-604. The low spot had a stainless-steel, condensate drain line that joined a stainless-steel, condensate drain line that came from the bottom of the main exhaust stack. The combined condensate drain line drained to the PEW evaporator waste collection tank, WL-102. That configuration was designed for low flows of liquid (condensate) that were low in acidity. However, the configuration of the condensate drain system changed as INTEC grew and added new processes, and the original system configuration was not compatible with the expanded INTEC processes.

As new INTEC processes were built, there was a need for additional waste transfer lines into the PEW evaporator feed collection system, WL-102. Since WL-102 was already in radioactive service, access to the tank was not possible due to high radiation fields. Therefore, when an addition to WL-102 was made, it was done by connecting the new line to an existing pipe line outside of the WL-102 vault. Over a period of about 10 years, several additions were made to the combined stack/tank farm relief condensate drain line. In 1955, a new line was added to transfer the aqueous portion of the new waste solvent collection tank (LE-102) to WL-102. In 1957, a line was added to remove liquid from the sump of a new PEW evaporator pump pit. In 1959, a new line was added to transfer waste from the WCF waste collection tank (WC-119) to WL-102. Each of these projects required excavation and piping modifications in the immediate vicinity of the low-point drain of the 12-in., carbon-steel, tank farm relief line. None of the modifications found any contaminated soil in the construction area.

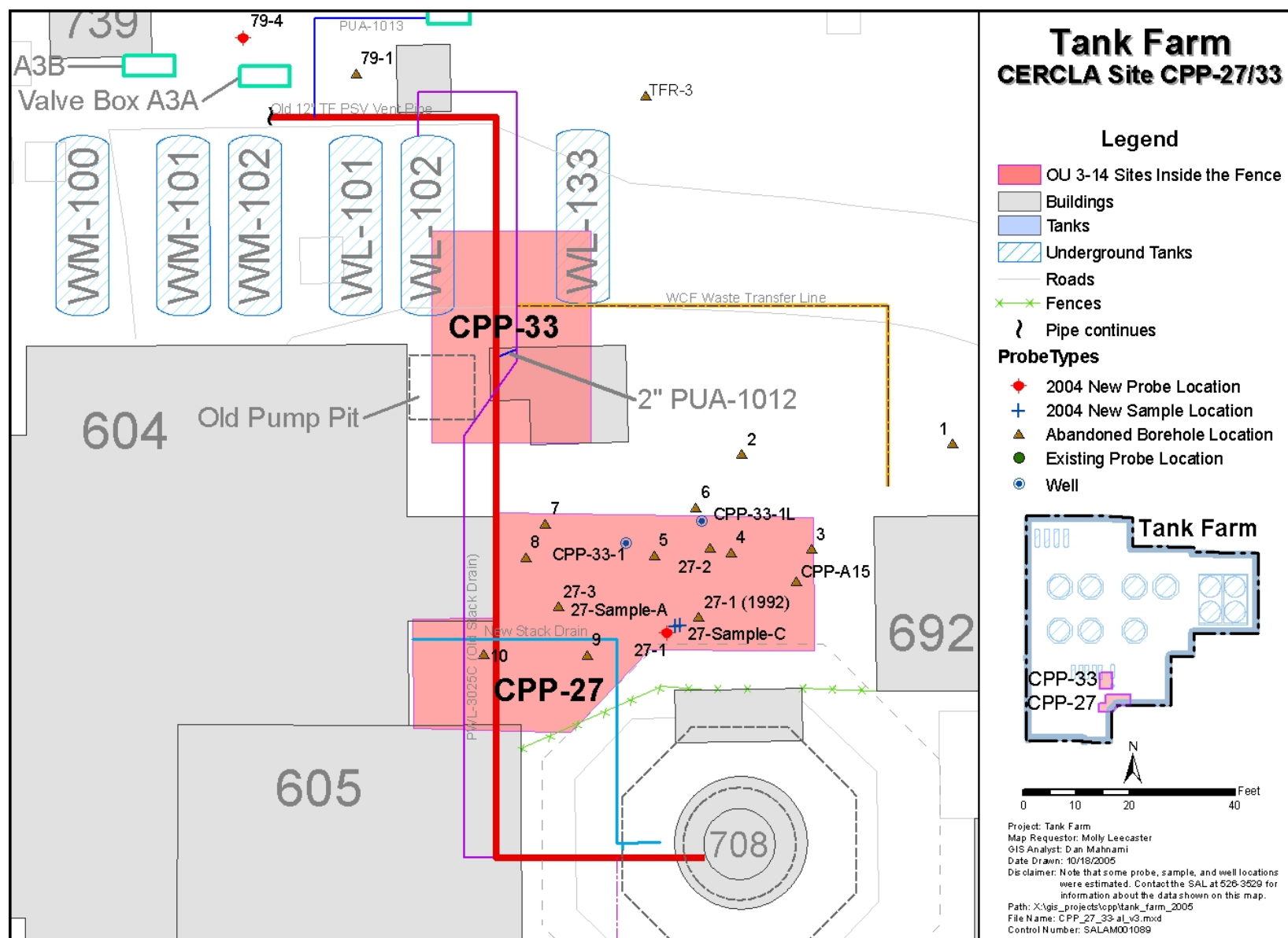


Figure 5-13. CPP-27/33 release sites showing location of 12-in. pressure relief line and associated piping and borehole/well locations.

The contamination at Site CPP-27 was found in April 1974 during the construction of a new PEW evaporator cell and pump pit on the east side of CPP-604. The contamination included an estimated 25-30 yd³ of highly contaminated soil (greater than 25 R/hr) and additional amounts of soil with lower levels of contamination. The bulk of the contaminated soil was removed as part of the project to install the new PEW evaporator cell. A total of 250-300 yd³ of soil containing about 1,500 Ci of Cs-137 and Sr-90 was removed.

The cause of the contamination was the addition of waste transfer lines to the original tank farm pressure-relief line drain system that were not compatible with the original system. The original system was a low-volume, low-acidity, gravity-drain waste transfer system. The modifications turned it into a (relatively) high-volume, high-acid system. The liquid waste transfer line was located only about 2 ft below the carbon-steel pressure-relief line. A high-volume waste transfer could cause waste to back up into the carbon-steel pressure-relief line via its low spot drain line. Acid solutions would cause a rapid failure of the carbon-steel pressure-relief line. Figure 5-14 shows the configuration of the carbon-steel tank farm pressure-relief line, its drain line, and the other lines that connected with the drain line that caused the soil contamination.

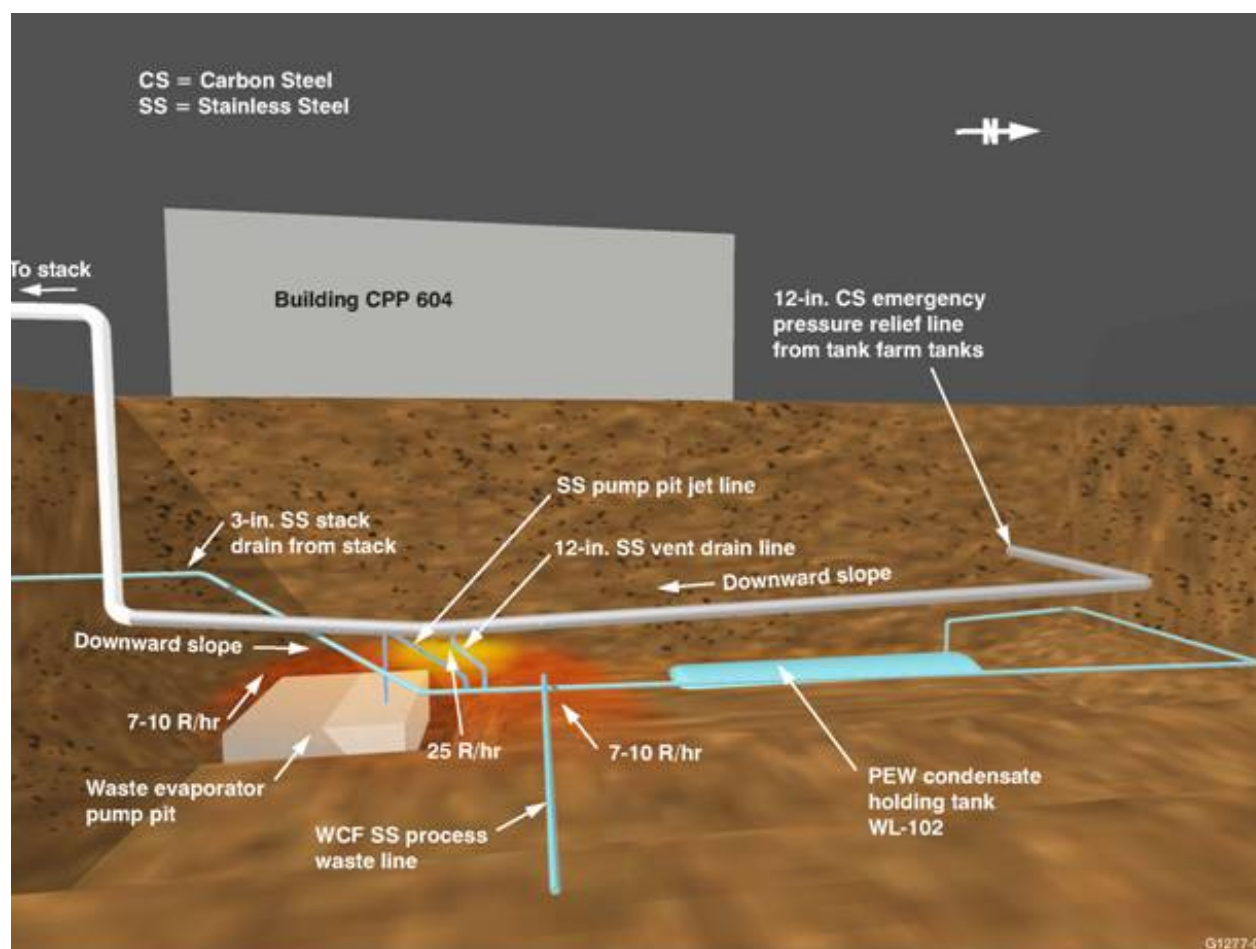


Figure 5-14. A cross section (looking west) of the carbon-steel tank farm pressure-relief line, its drain line, and other lines associated with the Site CPP-27/33 soil contamination.

The WCF was the primary source of high-acid and high-activity waste that caused both the failure of the carbon-steel pressure relief line and the subsequent soil contamination. The WCF began radioactive operation in December 1963, about 10 years before the discovery of the contaminated soil at CPP-27. During the first two operating campaigns (in the 1960s) the WCF quench system had some valve failures that prevented the normal recycling of scrub solution into the feed system. Some of the scrub solution went into the waste collection tank, WC-119, and was then transferred to the PEW evaporator collection tank, WL-102. Approximately 100,000 gal of WCF scrub solution were transferred to the PEW evaporator during each of the first two WCF operating campaigns (Commander et al. 1966; Swenson 2002). Some of that solution backed up into the carbon-steel pressure-relief line, dissolved the line, and contaminated the soil at CPP-27.

5.8.1.2 Waste Source Term. There were several possible sources of contamination at CPP-27 because several processes were connected to the tank farm pressure-relief system drain line. However, the WCF scrub solution had by far the most activity per unit volume of any of the sources of waste and was frequently transferred to WL-102 in the mid-1960s. The WCF scrub solution contained condensate from the WCF off-gas and dissolved calcine that had been entrained in the calciner off-gas and removed in the off-gas scrubbing system. The radionuclide activity of the scrub solution for most (nonvolatile) species was about one-fourth that of the feed solution (Commander et al. 1966). The Cs-137 activity of the Al waste calcined in WCF Campaign H-1 averaged about 1.5 Ci/L (5.7 Ci/gal). Assuming the scrub solution activity was one-fourth the feed solution activity means the Cs-137 activity was about 0.38 Ci/L (1.4 Ci/gal) in the scrub solution. The WCF processed waste from primarily from Al-clad fuels reprocessing in its first two campaigns. Using the radionuclide source term in Wenzel (2004) (modified as noted) yields the following estimated radiological source term for the WCF scrub solution:

Cs-137 = 1.4 Ci/gal

Sr-90 = 1.3 Ci/gal

H-3 = 2.3 mCi/gal (see explanation below)

Tc-99 = 0.22 mCi/gal

I-129 = 0.62 μ Ci/gal (see explanation below).

The values of H-3 and I-129 were adjusted from the Wenzel (2004) estimates. The value of H-3 was doubled because Wenzel (2004) is for coprocessing waste, which is a mixture of waste from reprocessing aluminum- and zirconium-clad fuels. First-cycle waste from Al-clad fuel retained most of the H-3 originally in the fuel, while most of the H-3 in Zr-clad fuel was lost as hydrogen gas when the fuel was dissolved. The activity of H-3 in Al waste is approximately double its activity in coprocessing waste. The activity of I-129 was increased by a factor of two to account for its volatility and condensation in the calcination process. Studies have shown I-129 activity accumulates in the calciner scrub system (McManus 1982). Because I-129 builds up in the scrub system, its activity could be lower or higher than the value above, by perhaps a factor of two.

The nitrate content of the WCF scrub solution averaged about 4.5 molar (Commander et al. 1966).

5.8.1.3 Waste Volume Released. The amount of waste released at Site CPP-27 is not precisely known. One can calculate the volume of high-activity scrub solution released by dividing the total activity released at the site (based on radiation measurements of the waste boxes containing the contaminated soil) by the activity of the scrub solution. Previous tank farm soil contamination reports estimated the activity

released between 1,000 and 3,000 Ci (sum of Cs-137 and Sr-90). The original investigation report was reviewed to determine the reason for the wide range in the estimate of the activity released. The reason for the range was the variability in the measurements of Sr-90 in the soil samples taken at the time of the discovery of the leak (Staiger 1974). The activity of the Cs-137 was reliably measured and its release estimate was consistently about 750 Ci. However, the measured activity of the Sr-90 varied from a factor of 3 times to a factor of 1/3 that of the Cs-137 activity in the soil (2,250 Ci to 225 Ci). As a result, the total Cs-137 plus Sr-90 activity varied from 1,000 to 3,000 Ci. The activity of the Sr-90 released was virtually the same as that of the Cs-137. The variation in the Sr-90 activity was due to the difficulty of analyzing the soil samples for Sr-90. A better estimate of the Sr-90 activity would be to assume it was 96% of the Cs-137 activity (Wenzel 2004) or about 720 Ci. The total Cs-137 plus Sr-90 activity would then be about 1,500 Ci.

Assuming 750 Ci of Cs-137 were released and the WCF scrub solution contained 1.4 Ci/gal Cs-137, the volume of waste released was 540 gal. This is reasonably close to the original estimate of 300 gal. The estimated volume will vary, depending on the assumed activity of the WCF scrub solution.

It is also possible that additional low-activity waste was released that contained activity that cannot be distinguished from the release of the high-activity scrub solution. A leak of 540 gal of the greater-than 200,000 gal of scrub solution transferred through the line is only about one-fourth of 1% of the volume transferred through the line. If the same percentage of low-activity waste also leaked to the soil, it is possible another 500 gal of low-activity, high-nitrate waste also leaked. From a source term perspective, the additional 500 gal would have contributed no additional measurable activity. However, the low-activity waste would have been nitric-acid-based decontamination solution and contained nitrate concentrations similar to the scrub solution.

5.8.1.4 Source Term Summary. Sites CPP-27 and CPP-33 were contaminated when transfers of nitric acid solution from the WCF to the PEW evaporator backed up (via a drain line) into the carbon-steel tank farm pressure-relief line. The acidic solution dissolved the carbon-steel line and then leaked into the surrounding soil. The bulk of the contamination occurred during the mid-1960s, during the first two WCF operating campaigns, when valve failures at WCF resulted in large quantities (over 200,000 gal) of WCF scrub solution being sent to the PEW evaporator. Table 5-21 shows the contaminants released to Sites CPP-27 and CPP-33 assuming 540 gal of WCF scrub solution and an additional 500 gal of low-activity, 4.5-molar nitric acid waste (such as decontamination solution) leaked. Although the amount of activity released is significant, the activity of most of the radionuclides released is an order of magnitude less than the activity released at Site CPP-31. In addition, most of the nonmobile activity was removed during the construction projects that discovered the contamination.

5.8.2 Cleanup

The soil contaminated by releases from the leaking 12-in., carbon-steel pressure-relief line located 12 ft bgs was excavated in 1974 to the depth of the CPP-604 basement, just above basalt (Figure 5-14). The contamination had leaked vertically downward to a depth of 16 ft below the pipe (28 ft bgs) and laterally as far as 20 ft. The soil surrounding the corroded pipe had radiation readings up to 25 R/hr. A total of approximately 275 yd³ of soil was removed from the site. Analysis of samples collected from the site in 1974 indicated Cs-134, Cs-137, Sr-90, Eu-154, Sb-125, Ru-106, and Pu-239/240 were present in the contaminated soil. Cs-137 activities in the four samples collected over nearly a 3-month period ranged from 2.89E+4 to 3.03E+6 pCi/g. The Sr-90 activities in three samples ranged from 9.45E+4 to 8.59E+4 pCi/g, and Pu-239/240 activities in two samples were 4.59E+2 to 2.97E+3 pCi/g. No other analyses are known to have been performed. After removal of the contaminated soil, only 25 mCi of radioactivity were estimated to remain at the site.

In 1983, additional contaminated soil attributed to the corroded line was encountered in the same general area while excavating soil to replace Tank WL-102. During excavation activities, the clean soil (which may have ranged from background up to approximately 5 mR/hour) was separated from contaminated soil for use as backfill once construction was complete. Approximately 14,000 yd³ of contaminated soil were removed from the site (see Figures 5-15, 5-16, and 5-17). Of this total, approximately 2,000 yd³ had contact beta-gamma radiation levels exceeding 30 mR/hr. This soil was removed and disposed of at the RWMC. The remaining 12,000 yd³ were disposed of in trenches located in the northeast corner of INTEC^b. The excavated area was backfilled using the stockpiled clean soil and clean off-Site soil, and a portion of the area was covered by an asphalt road. WINCO (1993a) reported that some residual contamination remained below and to the sides of the excavated area, but the original document that was cited by the report does not confirm this. However, the sides of the excavation shown in Figure 5-16 appear to have a gunite coating for slope stabilization that might have been used to provide some shielding to workers.

Section 5.18 of this report, which describes the extent of excavation and backfilling in the tank farm boundary, further discusses CPP-27/33, including extent of excavations in 1974 and 1983.

5.8.3 Previous Investigations

In 1987, 10 observation boreholes were drilled to the top of basalt in the CPP-27/33 area to determine the extent of contamination (see Figure 5-18). Direct radiation readings were taken in the observation boreholes using field instruments. No samples were collected from the boreholes for laboratory analysis. Information on the total depth of each borehole is also unavailable. Beta-gamma radiation readings in the boreholes ranged from none detected to 30 mR/hour.

In 1990, a 113-ft-deep borehole was made in the area (completed as monitoring well CPP-33-1, see Figure 5-18). Sixteen soil samples were collected from the soil above the basalt and two soil samples were collected from the 110-ft interbed. The samples were analyzed for a full suite of constituents, including VOCs, SVOCs, metals, dioxins and furans, cyanide, and radionuclides. The primary contaminants detected in the soil were Cs-137 and Sr-90 (Table 5-22). The highest activities found were between 7 and 29 ft bgs. The maximum activity detected for Cs-137 was 606 ± 3 pCi/g at 25 ft bgs and for Sr-90 was 328 ± 1.8 pCi/g at 17 ft bgs (Golder 1991).

Sites CPP-27 and -33 were additionally characterized as part of the OU 3-08 Track 2 investigation in 1992 (WINCO 1993b). Three boreholes, labeled CPP-27-1, CPP-27-2, and CPP-27-3, were made at the site (see Figure 5-18). Borehole CPP-27-1 was drilled to 46 ft bgs, and the other two boreholes were drilled to 12 ft bgs. Twenty soil samples were collected and analyzed for VOCs, metals, selected anions, pH, and radionuclides. The selection of the appropriate depths to collect the soil samples from each borehole was based on the highest measured radiation reading on soil collected as the borehole was drilled.

Sixteen of 20 samples analyzed by gamma spectroscopy had Cs-137 activities above the expected background level of 0.82 pCi/g (INEL 1996). Elevated Cs-137 was measured in Borehole CPP-27-1 at depths from 2 to 22.5 ft bgs, in Borehole CPP-27-2 at depths from 4 ft to 10 ft bgs, and in Borehole CPP-27-3 at depths from 4 to 6 ft bgs. Slightly elevated alpha activities were found in Boreholes CPP-27-1 and CPP-27-3 at depths from 6 to 16 ft bgs and 4 to 12 ft bgs, respectively. The maximum Cs-137 concentration observed in the three boreholes was 1,370 pCi/g at 6-8 ft bgs in CPP-27-1. Analytical results for the soil samples collected from the three boreholes are presented in Table 5-23.

b. These trenches were identified as CPP-34 in the OU 3-13 ROD and are addressed as a Group 3 site in the OU 3-13 RD/RA.



Figure 5-15. Photo showing the CPP-27/33 release area during 1983 excavation (view looking west).



Figure 5-16. Photo showing the amount of soil removed from the CPP-27/33 release area during 1983 excavation (view looking south).



Figure 5-17. 1983 excavation within the CPP-27/33 release sites.

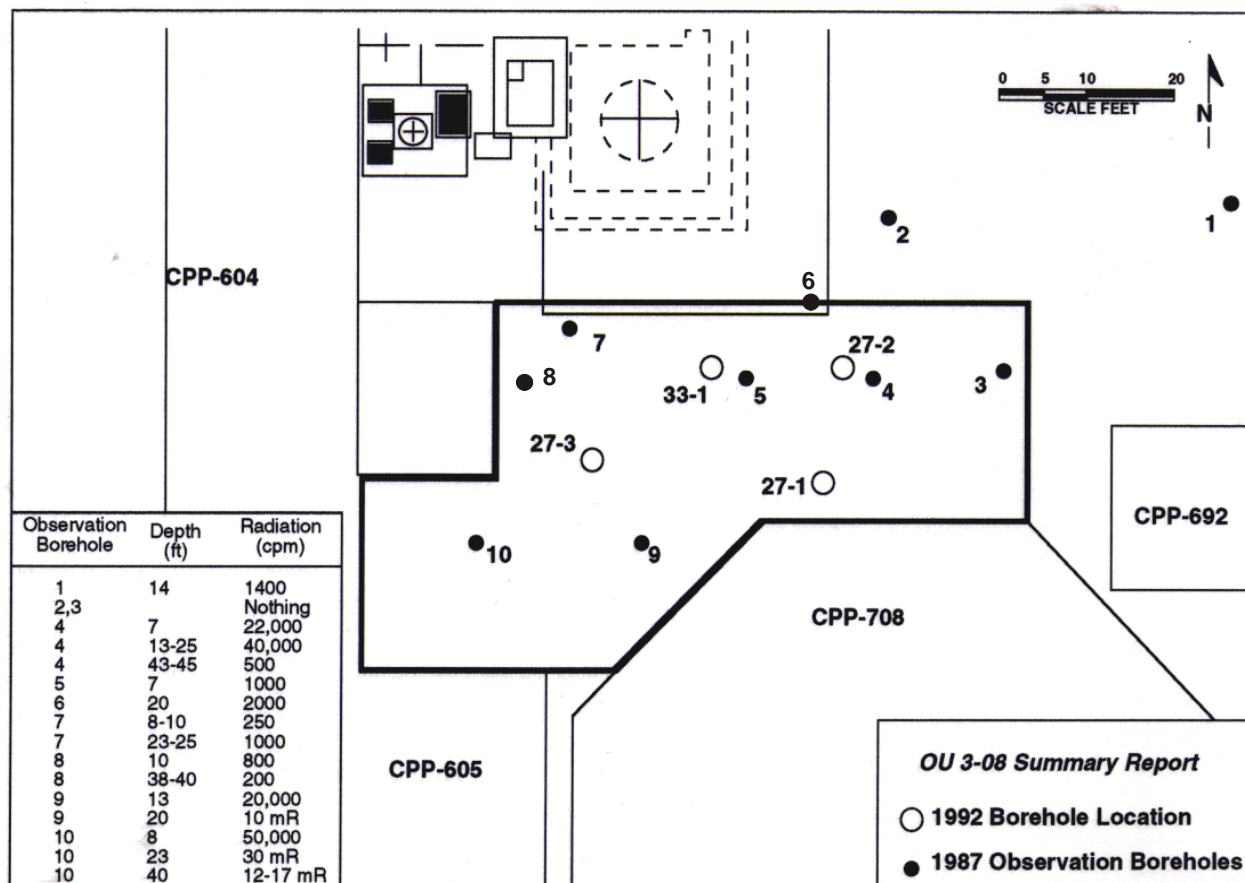


Figure 5-18. Map of Site CPP-27 showing the locations of previously drilled boreholes.

Table 5-22. Radionuclide sample analytical results for Borehole CPP-33-1 from 1990.

Borehole	Depth (ft)	Am-241 (pCi/g)	Sb-125 (pCi/g)	Ce-144 (pCi/g)	Cs-134 (pCi/g)	Cs-137 (pCi/g)	Co-58 (pCi/g)	Co-60 (pCi/g)	I-129 (pCi/g)	Np-237 (pCi/g)
CPP-33-1	1	2.04 ± 0.87	0.03 U	0.05 U	0.08 U	0.03 U	0.09 U	0.07 U	0.5 U	0.4 U
	3	0.05 U	0.03 U	0.05 U	0.08 U	0.40 U	0.09 U	0.07 U	0.5 U	0.5 U
	5	2.91 ± 2.02	0.03 U	0.05 U	0.08 U	0.40 U	0.09 U	0.07 U	0.5 U	0.5 U
	7	0.05 U	0.03 U	0.05 U	0.08 U	306 ± 4	0.09 U	0.07 U	0.5 U	0.5 U
	9	0.05 U	0.03 U	0.05 U	0.08 U	254 ± 3	0.09 U	0.07 U	0.5 U	0.5 U
	11	9.59 ± 1.59	0.03 U	0.05 U	0.08 U	53.0 ± 1.8	0.09 U	0.07 U	0.5 U	0.5 U
	17	0.05 U	0.03 U	0.05 U	0.08 U	219 ± 3	0.09 U	0.07 U	0.5 U	0.5 U
	21	0.05 U	0.03 U	0.05 U	0.08 U	416 ± 4	0.09 U	0.07 U	0.5 U	0.5 U
	25	0.05 U	0.03 U	0.05 U	0.08 U	606 ± 3	0.09 U	0.07 U	0.5 U	0.5 U
	29	0.05 U	0.03 U	0.05 U	0.08 U	298 ± 2	0.09 U	0.07 U	0.5 U	0.8 U
	33	0.05 U	0.03 U	0.05 U	0.08 U	10.3 ± 0.4	0.09 U	0.07 U	0.5 U	0.5 U
	37	0.05 U	0.03 U	0.05 U	0.08 U	121 ± 1	0.09 U	0.07 U	0.5 U	1.14 ± 0.60
	39	0.05 U	0.03 U	0.05 U	0.08 U	0.42 ± 0.07	0.09 U	0.07 U	0.5 U	0.5 U
	41	0.05 U	0.03 U	0.05 U	0.08 U	0.12 ± 0.07	0.09 U	0.07 U	0.5 U	0.68 ± 0.27
	45	0.39 ± 0.24	0.03 U	0.05 U	0.08 U	2.37 ± 0.15	0.09 U	0.07 U	0.5 U	0.6 U
	47	0.05 U	0.03 U	0.05 U	0.08 U	2.13 ± 0.07	0.09 U	0.07 U	0.5 U	0.3 U
	112	0.05 U	0.03 U	0.05 U	0.08 U	0.04 U	0.09 U	0.07 U	0.5 U	0.38 ± 0.17
	113	0.05 U	0.03 U	0.05 U	0.08 U	0.08 U	0.09 U	0.07 U	0.5 U	0.4 U
Borehole	Depth (ft)	Pu-239/240 (pCi/g)	Pu-238 (pCi/g)	Ru-103 (pCi/g)	Ru-106 (pCi/g)	Sr-90 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	
CPP-33-1	1	0.34 ± 0.12	0.46 ± 0.12	0.2 U	0.07 U	2.87 ± 0.20	0.09 ± 0.02	0.05 U	0.09 ± 0.03	
	3	0.05 U	0.05 U	0.2 U	0.07 U	0.36 ± 0.10	0.15 ± 0.05	0.05 U	0.13 ± 0.04	
	5	0.05 U	0.06 ± 0.04	0.2 U	0.07 U	1.63 ± 0.15	0.10 ± 0.02	0.05 U	0.10 ± 0.02	
	7	0.05 U	0.05 U	0.2 U	0.07 U	102 ± 1.1	0.12 ± 0.03	0.05 U	0.09 ± 0.03	
	9	0.05 U	0.08 ± 0.05	0.2 U	0.07 U	281.7 ± 1.8	0.12 ± 0.03	0.05 U	0.09 ± 0.02	
	11	0.05 U	0.05 U	0.2 U	0.07 U	47.68 ± 0.74	0.08 ± 0.03	0.05 U	0.08 ± 0.03	
	17	0.05 U	0.05 U	0.2 U	0.07 U	328.8 ± 1.8	0.10 ± 0.03	0.05 U	0.13 ± 0.04	
	21	0.05 U	0.05 U	0.2 U	0.07 U	294.7 ± 1.7	0.16 ± 0.04	0.05 U	0.10 ± 0.03	
	25	0.05 U	0.05 U	0.2 U	0.07 U	163.5 ± 1.3	0.13 ± 0.02	0.05 U	0.11 ± 0.02	
	29	0.05 U	0.05 U	0.2 U	0.07 U	108.4 ± 1.1	0.12 ± 0.04	0.05 U	0.13 ± 0.04	
	33	0.05 U	0.05 U	0.2 U	0.07 U	6.0 ± 0.3	0.18 ± 0.04	0.05 U	0.26 ± 0.04	
	37	0.05 U	0.05 U	0.2 U	0.07 U	47.9 ± 0.7	0.05U	0.05 U	0.05U	
	39	0.05 U	0.05 U	0.2 U	0.07 U	0.87 ± 0.12	0.28 ± 0.09	0.05 U	0.30 ± 0.09	
	41	0.05 U	0.05 U	0.2 U	0.07 U	0.39 ± 0.11	0.32 ± 0.04	0.05 U	0.54 ± 0.05	
	45	0.05 U	0.05 U	0.2 U	0.07 U	2.5 ± 0.2	0.17 ± 0.03	0.05 U	0.18 ± 0.04	
	47	0.05 U	0.05 U	0.2 U	0.07 U	0.10 U	0.51 ± 0.19	0.05 U	0.63 ± 0.20	
	112	0.05 U	0.05 U	0.2 U	0.07 U	0.16 ± 0.08	0.07 ± 0.01	0.05 U	0.05 ± 0.01	
	113	0.05 U	0.05 U	0.2 U	0.07 U	0.18 ± 0.08	0.20 ± 0.02	0.05 U	0.19 ± 0.02	
U – Indicates the compound was analyzed for but not detected. The reported value is the sample quantitation limit.										

Table 5-23. Analytical results for the soil samples collected at CPP-27-1, 27-2, and 27-3 in 1992.

Borehole	CPP-27-1		CPP-27-1		CPP-27-1		CPP-27-1		CPP-27-1		CPP-27-1		CPP-27-1		CPP-27-1		CPP-27-1		CPP-27-1	
Depth (ft)	2 – 4		6 – 8		8 – 10		10 – 12		12 – 16		12 – 16 (Duplicate)		21 – 22.5		32 – 33.2		40 – 41.7		44 – 45.3	
Sample Number	30800101		30800201		30800301		30800401		30800501		30801101		30800601		30800701		30800801		30800901	
	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q
Mercury	0.06	B	0.14		0.08	B	0.14		0.33		0.24		0.27		0.05	U	0.05	U	0.06	U
Cadmium	1.10	U	1.10	U	1.10	U	1.10	U	1.10	U	1.10	U	1.10	U	1.10	U	1.10	U	1.20	
Fluoride	1.17	J	1.15	J	1.52	J	1.68	J	1.83	J	1.57	J	1.10	J	1.52	J	1.28	J	6.48	J
pH	8.88 (no units)		9.11 (no units)		9.13 (no units)		9.03 (no units)		9.08 (no units)		8.95 (no units)		9.13 (no units)		7.74 (no units)		8.26 (no units)		8.16 (no units)	
Nitrate	0.93	J	0.57	J	1.50	J	2.20	J	3.60	J	3.70	J	0.21	UJ	0.62	J	0.68	J	1.40	J
Nitrite	0.22	UJ	0.21	UJ	0.21	UJ	0.22	UJ	0.22	UJ	0.21	UJ	0.21	UJ	0.21	UJ	0.22	UJ	0.25	UJ
Radionuclides	Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)	
Gross Alpha	1.12E+01 ± 1.74E+00		7.93E+01 ± 9.77E+00		2.97E+01 ± 3.82E+00		8.61E+00 ± 1.26E+00		2.56E+01 ± 3.23E+00		6.30E+01 ± 1.14E+01		1.11E+01 ± 1.70+00		1.10E+01 ± 1.64+00		1.26E+01 ± 1.86+00		3.44E+01 ± 5.25E-01	
Gross Beta	2.82E+01 ± 2.52E+00		1.73E+03 ± 1.39E+02		6.23E+02 ± 5.02E+01		1.67E+02 ± 1.38E+01		1.27E+03 ± 1.02E+02		1.65E+03 ± 1.32E+02		6.13E+01 ± 4.44E+00		2.66E+01 ± 2.35E+00		2.43E+01 ± 2.19E+00		2.23E+01 ± 2.05E+00	
Cs-137	4.62E+00 ± 3.81E-01		1.37E+03 ± 1.00E+02		5.93E+02 ± 5.03E+01		9.41E+02 ± 6.88E+01		9.00E+02 ± 6.58E+01		9.28E+02 ± 6.28E+01		1.35E+01 ± 9.14E-01		5.80E-01 ± 4.22E-02		1.39E+00 ± 1.17E-01		9.95E-01 ± 7.20E-02	
Eu-154	ND		4.23E+00 ± 3.35E-01		6.34E-01 ± 9.50E-02		1.32E+00 ± 1.58E-01		1.41E+00 ± 2.08E-01		1.30E+00 ± 1.72E-01		ND		ND		ND		ND	
K-40	1.97E+01 ± 9.37E-01		1.50E+01 ± 1.11E+00		1.99E+01 ± 1.07E+00		1.58E+01 ± 1.13E+00		1.57E+01 ± 1.16E+00		2.02E+01 ± 1.20E+00		2.11E+01 ± 1.02E+00		2.06E+01 ± 1.00E+00		2.26E+01 ± 1.07E+00		2.34E+01 ± 1.14E+00	
Sr-90	NA		4.17E+02 ± 1.43E+01		1.34E+02 ± 7.58E+00		5.60E+01 ± 4.97E+00		4.66E+02 ± 1.44E+01		5.06E+01 ± 1.64E+01		8.54E+00 ± 1.04E+00		NA		NA		NA	
U-234	NA		1.04E+00 ± 6.31E-02		1.17E+00 ± 7.54E-02		NA		1.06E+00 ± 7.19E-02		NA		NA		NA		NA		9.92E-01 ± 7.29E-02	
U-235	NA		3.50E-02 ± 9.75E-03	U	4.25E-02 ± 1.24E-02	U	NA		3.40E-02 ± 1.12E-02	U	NA		NA		NA		NA		6.83E-02 ± 1.71E-02	
U-238	NA		1.05E+00 ± 6.34E-02		1.16E+00 ± 7.51E-02		NA		8.63E-01 ± 6.33E-02		NA		NA		NA		NA		1.10E+00 ± 7.74E-02	
Pu-238	NA		1.41E+00 ± 8.32E-02		5.69E-01 ± 6.28E-02		NA		1.95E-01 ± 2.99E-02		NA		NA		NA		NA		2.91E-01 ± 4.04E-02	
Pu-239	NA		1.66E-01 ± 2.34E-02		1.12E-01 ± 2.19E-02		NA		9.52E-02 ± 2.08E-02		NA		NA		NA		NA		4.67E-02 ± 1.57E-02	
Am-241	NA		4.97E-01 ± 7.22E-02		1.28E-01 ± 6.78E-02	J	NA		1.92E-01 ± 3.52E-02		NA		NA		NA		NA		3.06E-01 ± 9.35E-02	J

Table 5-23. (continued).

Borehole	CPP-27-2		CPP-27-2		CPP-27-2		CPP-27-2		CPP-27-2	
Depth (ft)	4 – 6		4 – 6 (Duplicate)		6 – 8		8 – 10		10 – 12	
Sample Number	30801201		30801601		30801301		30801401		30801501	
	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q
Mercury	0.05	B	0.05	U	0.05	U	0.05	U	0.05	U
Cadmium	1.10	U	1.10	U	1.10	U	1.70		1.10	U
Fluoride	1.03	J	0.99	J	1.26	J	1.22	J	0.75	J
pH	8.79 (no units)		9.19 (no units)		8.84 (no units)		8.95 (no units)		8.80 (no units)	
Nitrate	1.10	J	1.10	J	1.10	J	0.38	J	0.65	J
Nitrite	0.21	UJ	0.21	UJ	0.21	UJ	0.21	UJ	0.21	UJ
Radionuclides	Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)	
Gross Alpha	1.55E+01 ± 2.13E+00		1.22E+01 ± 1.68E+00		1.67E+01 ± 2.33E+00		1.98E+01 ± 2.69E+00		1.00E+01 ± 1.60E+00	
Gross Beta	2.12E+02 ± 1.73E+01		2.63E+02 ± 2.14E+01		1.90E+02 ± 1.58E+01		2.55E+02 ± 2.08E+01		2.74E+01 ± 2.46E+00	
Cs-137	4.93E+01 ± 3.77E+00		5.30E+01 ± 4.04E+00		5.31E+01 ± 3.61E+00		5.40E+01 ± 3.88E+00		1.08E+00 ± 8.07E-02	
Eu-154	4.05E-01 ± 9.24E-02		ND		ND		ND		ND	
K-40	1.64E+01 ± 9.17E-01		2.01E+01 ± 1.03E+00		1.74E+01 ± 1.05E+00		1.93E+01 ± 1.00E+00		1.98E+01 ± 1.09E+00	
Sr-90	8.66E+01 ± 5.25E+00		1.10E+02 ± 6.00E+00		7.05E+01 ± 4.41E+00		8.50E+01 ± 4.70E+00		NA	
U-234	NA		NA		NA		NA		NA	
U-235	NA		NA		NA		NA	U	NA	U
U-238	NA		NA		NA		NA		NA	
Pu-238	NA		NA		NA		NA		NA	
Pu-239	NA		NA		NA		NA		NA	
Am-241	NA		NA		NA		NA		NA	J

Table 5-23. (continued).

Borehole	CPP-27-3		CPP-27-3		CPP-27-3		CPP-27-3		CPP-27-3	
Depth (ft)	2 – 4		4 – 6		6 – 8		6 – 8 (Duplicate)		10 – 12	
Sample Number	30801701		30801801		30801901		30802101		30802001	
	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q	Concentration (mg/kg)	Q
Mercury	0.05	U	0.08	B	0.05	U	0.05	B	0.06	U
Cadmium	1.10	U	1.10	U	1.10	U	1.10	U	1.10	U
Fluoride	6.72	J	1.41	J	1.02	J	0.92	J	1.65	J
pH	9.25		9.13		9.15		9.20		8.87	
Nitrate	0.21	UJ	0.22	UJ	0.46	J	0.56	J	0.45	J
Nitrite	0.21	UJ	0.22	UJ	0.22	UJ	0.21	UJ	0.22	UJ
Radionuclides	Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)		Concentration (pCi/g)	
Gross Alpha	6.96E+00 ± 1.13E+00	J	4.60E+01 ± 5.83E+00	J	3.31E+01 ± 4.40E+00	J	1.56E+01 ± 2.19E+00	J	2.31E+01 ± 3.00+00	J
Gross Beta	2.64E+01 ± 2.36E+00		6.88E+02 ± 5.54E+01		2.96E+02 ± 2.41E+01		1.80E+02 ± 1.48E+01		5.19E+02 ± 4.19E+01	
Cs-137	7.39E-01 ± 5.68E-02		1.63E+02 ± 1.24E+01		4.81E+01 ± 3.52E+00		5.57E+01 ± 4.70E+00		3.60E+00 ± 3.03E-01	
Eu-154	ND		3.86E-01 ± 7.00E-02		ND		ND		ND	
K-40	2.18E+01 ± 1.04E+00		2.20E+01 ± 1.19E+00		1.99E+01 ± 1.17E+00		1.94E+01 ± 1.03E+00		1.89E+01 ± 9.00E-01	
Sr-90	NA		2.52E+02 ± 1.02E+01		4.70E+01 ± 3.44E+00		6.97E+01 ± 3.98E+00		2.34E+02 ± 1.00E+01	
U-234	NA		1.22E+00 ± 7.96E-02		1.10E+00 ± 6.97E-02		NA		1.08E+00 ± 7.68E-02	
U-235	NA		6.75E-02 ± 1.62E-02		6.90E-02 ± 1.50E-02		NA		3.36E-02 ± 1.20E-02	U
U-238	NA		1.16E+00 ± 7.71E-02		1.17E+00 ± 7.24E-02		NA		9.57E-01 ± 7.12E-02	
Pu-238	NA		7.76E-01 ± 6.26E-02		1.11E-01 ± 2.08E-02		NA		2.99E-02 ± 1.23E-02	U
Pu-239	NA		2.91E-01 ± 3.58E-02		2.58E-02 ± 9.80E-03	U	NA		3.49E-02 ± 1.33E-02	U
Am-241	NA		2.12E-01 ± 6.76E-02	J	1.39E-01 ± 4.22E-02		NA		1.18E-01 ± 3.43E-02	
U = Indicates the compound was analyzed for but not detected. The reported value is the sample quantitation limit. UJ = indicates the compound was analyzed for but not detected and the reported value is an estimate of the sample quantitation limit. J = indicates the value reported is an estimate. B = indicates the value reported is less than the contract required quantitation limit but greater than the instrument detection limit. NA = not applicable. ND = not detected. Q = qualifier.										

5.8.4 OU 3-14 Investigation

5.8.4.1 Scope. The OU 3-14 field investigation was focused on resolving remaining data gaps for CPP-27/33 described below. Details of the OU 3-14 field investigation at CPP-27/33 are provided in Appendix H. These include

- Sample collection procedures
- Sample documentation, custody, handling, and transportation
- Analytical methods
- Data reporting
- Quality control.

Details of the location and installation of gamma logging probeholes and sampling coreholes are provided in Appendix F.

5.8.4.2 DQOs. DQOs for the OU 3-14 field investigation for CPP-27/33 are summarized in Table D-7 of DOE-ID (2004). The composition of contamination present was inadequately known to resolve Decision Statements 2 and 3. Specifically, the relatively shallow location contamination observed in the 6-8 ft bgs interval at CPP-27-1 was considered anomalous because it occurred above the depth of the CPP-27/33 release and was therefore potentially indicative of a separate release. Sampling results were inadequate to define the composition of the contamination.

The field investigation strategy formulated to obtain the decision inputs needed to resolve the decision statements included

- One corehole to basalt adjacent to CPP-27-1, sampling and analysis for the COPCs listed in Table 5-5, and archiving of excess sample material for possible subsequent K_d or treatability studies.

Probehole installation is described in Appendix F. Samples were collected in 2-ft intervals in core barrels using GeoProbe direct-push tooling and analyzed for the constituent list shown in Table 5-5. Results are summarized in Table 5-24 below and are provided in total in Appendix G. Casing was installed and the hole was gamma-logged using the AMP-50. Gamma readings for each depth interval are listed in Table D-1 of Appendix F.

5.8.4.3 Probing and Gamma Logging Investigation. Probehole installation is described in Appendix F. Probehole CPP-27-1 (CPP-1870) was pushed 42.2 ft to basalt at the location shown on Figure 5-18. The probehole was gamma-logged using both the AMP-50 and AMP-100. Gamma-logging results are shown in Appendix F.

Probehole 27-Sample-A (CPP-1871) was pushed at the location shown on Figure 5-18 to 19.5 ft bls where refusal was encountered. Samples were collected in 4-ft intervals in core barrels using GeoProbe direct-push tooling and analyzed for the constituent list shown in Table 5-5. Probehole 27-Sample-B (CPP-1872) was pushed to refusal at 20 ft bls and abandoned. Probehole 27-Sample-C (CPP-1873) was pushed at the location shown on Figure 5-18 to refusal at 40 ft bgs. Samples were collected from Probehole 27-Sample-C (CPP-1873) in 4-ft intervals from 20 to 36 ft bgs in core barrels using GeoProbe direct-push tooling and analyzed for the constituent list shown in Table 5-5. Results are discussed below and are provided in total in Appendix G.

Table 5-24. Summary of OU 3-14 field investigation sampling and analysis results for CPP-27-Sample-A and CPP-27-Sample-C (CPP-1871 and CPP-1873 respectively).

Depth (ft)	Cs-137 (pCi/g)	Sr-90 (pCi/g)	Pu-238 (pCi/g)	Pu-239/240 (pCi/g)	I-129 (pCi/g)	Tc-99 (pCi/g)	Am-241 (pCi/g)	Eu-154 (pCi/g)	U-233/234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Np-237 (pCi/g)	H-3 (pCi/g)	As (mg/kg)	Cr (mg/kg)	Hg (mg/kg)	Nitrate-N (mg/kg)	pH (None)
2-4	0 ^a	ND ^b	ND	ND	ND	ND	ND	ND	0	0	0	ND	ND	11.4	31.8	0.03	3	9.1
6-8	40	126	0.1	0	ND	ND	0	ND	1	0	1	ND	ND	10.1	25	0.04	3	8.9
10-12	25	8	ND	ND	ND	ND	0	ND	0	0	0	ND	ND	11.2	26	0.05	4	9.1
14-16	288	711	0.1	ND	ND	ND	0	0	0	0	1	ND	ND	7.75	30.7	0.05	3	9.3
18-20	7	24	ND	ND	ND	4	0	ND	1	0	1	ND	ND	10.5	31.6	0.02	3	9.2
20-24	ND	ND	ND	ND	ND	7	ND	ND	1	0	1	ND	ND	5.76	33.9	0.03	3	9.2
24-28	ND	ND	ND	ND	ND	3	ND	ND	1	0	1	ND	ND	11	42.3	0.03	2	8.7
28-32	ND	ND	ND	ND	ND	ND	0	ND	1	0	1	ND	ND	8.9	27.9	0.03	3	8.6
32-36	ND	ND	ND	ND	ND	ND	ND	ND	1	0	1	ND	ND	13	26.3	0.02	2	8.3

a. 0 = Compound detected at less than 0.05 (decimal places not shown). For uncertainty and more analytical details, see Appendix G.
b. ND = nondetect (U) or false positive (UJ).